THE IMPORTANCE AND VALUES OF WILD PLANTS AND ANIMALS IN AFRICA

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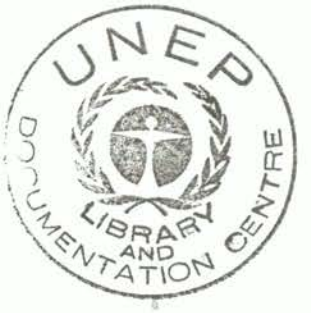
PART I



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FOREWORD

This report is a logical follow-up to an earlier study on "Wildlife Utilization and Game Ranching", sponsored by IUCN, (Mossman and Mossman, 1974-75).

That study examined at length the economic potential of large wild ungulates either through ranching or through the exploitation of stocks in wildlife reserves, based on experience gained in southern Africa. However, there is a wealth of varied wildlife resources outside the large ranches and wildlife reserves. It is these resources of wild fauna and flora which significantly contribute to the daily well-being of the rural, and often urban, human populations in Africa, particularly those in West and Central Africa. The problem, however, is how to assure the sustainability of these resources in the light of rapid changes brought about through the modernization of rural Africa.

The study carried out by Dr Sale partially answers the question. More important, however, it underlines the little-recognized value of these resources to the overall economy of African countries. Follow-up suggestions are made but it seems, and this is supported by comments from reviewers, that the speed of rural development in Africa argues for urgent intervention by those in governments responsible for conservation of wild fauna and flora. Development institutions and international organizations concerned with the conservation of living natural resources can also help governments in the design of rural development projects in which the conservation of these wild resources is an integral part.

In addition to review within the IUCN network, comments were received from a number of experts in Africa and others whose knowledge of Africa could usefully contribute to the study. These included:

Dr Sunday S Ajayi (Nigeria)
Dr EOA Asibey (Ghana)
Mr G Child (FAO, Rome)
Dr James Kahurananga (ILCA, Addis Ababa)
Mr Cyril de Klemm (IUCN/CEPLA)
Dr Lydia Makhubu (Swaziland)
Mr Liberty Mhlanga (ENDA, Dakar)
Mr Solomon ole Saibull (Tanzania)
Dr Jeremy Swift (ILCA, Bamako)

The reviewers brought to light some interesting facts and suggestions which have been incorporated in the report. A number of these, as exemplified by the few extracts given below, went to great length in discussing the problem.

> "... in marginal arid agricultural and especially pastoral areas there is enormous reliance on wild foods, especially grass seeds and wild animals. One of the reasons for the severity of the 1973 Sahelian drought was that hunting, principally by government officials, customs and army officers from vehicles with automatic rifles, had wiped out the wild animals which many pastoralists affected by the drought would have hunted for food. In contingency planning for future droughts of this sort, wild animals and plants have a very important role to play, and this would provide an excellent rationale for protection of a very wide range of species in a wide range of habitats."

> "... information from studies on hunting and gathering by Botswana Bushmen or the San (Lee and Devore, 1976) is now being used to design development programmes for Bushmen. A new publication "The future of nomads in Africa: traditional hunters, gatherers and nomadic pastoralists and modern change" (International African Institute, London, 1980) throws a great deal of light on the dependance of the concerned tribes on wild plants and animals." (SWIFT)

> "... a week's stay with a family of Botswana's Basarwa in the Kalahari would be an eye opener and sensitizer as to the perceptions and knowledge of these local people about their ecology. During a recent drought some Basarwa survived on about 250 species of plants from the bush. The Basarwa have an encyclopaedic store of knowledge about flora and fauna in their environment probably quite favourably compared to a regular PhD in the same subject. There is some interesting work already going on in Nigeria (Ife), Swaziland (Kwaluzeni), Tanzania, Mozambique, Benin, Togo, the Republic of South Africa, Malawi, Gambia, Sierra Leone, etc." (MHLANGA)

> "... recommendations should be implemented soon in order to ... identify gaps until the picture is completed and this important aspect of conservation is put on continued monitoring basis ... as indicative of local conditions that threaten species. Licensing is a less suitable means for gathering information on ecological impact of the bushmeat trade due to possible suppression of information; other methods need to be investigated and mathematical models fitted, as is now being attempted with information gathered in Kantamanto, Ghana." (ASIBEY)

IUCN takes this opportunity to convey its gratitude to these contributors, and especially to Dr Sale who had the exacting but rewarding task of producing this report.

This survey would not have taken place were it not for the cooperation received from the United Nations Environment Programme through the UNEP/IUCN Project FP/1110-79-01. Similarly, the contribution of the International Foundation for the Conservation of Game (IGF) towards the publication of the report is much appreciated.

Now that the potential value of wildlife resources is becoming more widely recognized in Africa, partial though this recognition may still be, IUCN hopes that similar surveys can be carried out in other parts of the world, particularly in the light of the **World Conservation Strategy**'s emphasis on species and genetic resources conservation. In the meantime, IUCN wishes to recommend to the governments in Africa the findings and conclusions of this survey, and in this way to take measures which will foster the role which these resources continue to play.

I. INTRODUCTION

The aim of this report is to demonstrate the current economic and cultural importance of the wild fauna and flora in Africa and to indicate ways by which this importance may be maintained and intensified. Viewed from a world perspective, Africa's wildlife is one of its best-known and most appreciated assets and yet it has to be admitted that there is generally but a scant awareness of the real importance of this resource in either economic or cultural terms. And there is even less understanding of the place which wild animals and plants occupy in Africa's own thinking and traditional philosophy. Many of the reasons currently given as to why African wildlife should be conserved take little account of the attitudes of the African people themselves toward this resource but are largely based on the feelings of western man towards wild species. The present report represents an attempt to redress some of this imbalance and to improve the rationality for conservation in Africa.

The approach has been to examine the state of existing knowledge on the non-commercial uses of wild plants and animals in Africa. From this information base some general conclusions are drawn about the importance and values given by Africans to their wildlife. How do Africans currently evaluate their wildlife in practice? And with what implications for conservation? Commercial utilization of wild animals and plants is largely covered by earlier reports on such subjects as tourism, game ranching, timber exploitation and the charcoal industry. Hence it was felt appropriate to confine this study to the more traditional and domestic forms of wildlife utilization: the grass-roots attitudes and patterns of usage that are common across large areas of the continent and which are usually closely interwoven with other customs and beliefs. Attention was concentrated on information published since the early 1960's, since which time there have been widespread changes in many of the countries which have attained independence. A few earlier papers were examined in order to lend perspective or to illustrate a long-established interest in some particular type of exploitation.

The study occupied the four months January to April 1978 and during this period correspondence and personal discussions were held with some 150 knowledgeable persons in 25 African countries and elsewhere. Chiefly as an aid to elucidation of the problem being researched, a questionnaire was designed which categorized much of the information being sought and emphasized the desirability of the accurate identification by their scientific names of wild species being used. Since it was primarily a documentation study, correspondents were asked to direct the author's attention to pertinent publications and sources of written information, although some provided valuable additional data by actually filling in the questionnaires from their own field knowledge. Literature was examined from a variety of disciplines, including agriculture, anthropology, botany, ethnobotany, ethnography, enthnozoology, forestry, medicine, nutrition, wildlife biology and zoology. A classified and annotated bibliography, of about 250 publications, mainly in English or French and referring to 35 African countries, was compiled and forms the chief source of information for what follows. (Only the actual bibliography is included in this publication.)

Clearly, a very brief documentation study of this kind in no way represents an exhaustive treatment of existing knowledge on the non-commercial uses of wild animals and plants in Africa. Rather, it should be regarded as an introduction to what is undoubtedly an important yet neglected aspect of African wildlife science. It is certainly hoped that this report will prompt further study and discussion of the importance and values that Africans themselves place on their enormously rich wild living resources.

II. IMPORTANCE AND VALUES OF WILD RESOURCES

Many of the answers on the importance and values of wild living resources are to be found by general considerations of such different types of literature as exist in the overall field. More specific areas of inquiry concern the economic, nutritional, medicinal and cultural importance that Africa places on its wildlife.

1. Patterns of Utilization, as Revealed by Literature

A general impression of the wide importance of wild plants and animals can be gained from the list of their uses in Appendix I and II, respectively. For plants, five major categories were perceived, as indicated in the arrangement of the bibliography: the use of plants as food, medicine, fodder for domestic stock, construction and crafts, and fuel. The most important use of animals was as food. Minor uses of plants and animals are listed under "various uses". For both, some extremely important considerations which cannot strictly be classified as "uses" are described under the heading of "cultural significance".

There is far more published information available on the uses of plants than on animals. One reason for this is the much greater variety of uses to which plants are commonly put, which has led to several well defined areas of study such as the medicinal uses of plants. Another reason is undoubtedly the fact that, in many of the countries, most wild animals can only be hunted legally after the purchase of a licence and allied bureaucratic procedures introduced during colonial times. This means that much traditional animal utilization is carried on illegally, making it difficult to obtain and publish information, particularly on the extent and distribution of the game harvest. It is interesting to reflect on the fact that it was chiefly the success of "traditional" methods of hunting that led to their being declared illegal.

There are a number of general publications on the uses of plants in various regions in Africa. For example, Irvine's (1961) "The Woody Plants of Ghana, with Special Reference to their Uses" is a 900-page volume describing the economic and other uses of some 350 species, most of which are wild. Chemical analyses are given of about 75 species which are used as human food and the nutritional value of 50 species of trees and shrubs used as fodder for domestic stock is indicated. An older work is Dalziel's (1937) "Useful Plants of Tropical West Africa", dealing with approximately 2,000 species, in a dozen countries. A complete revision is currently being undertaken by Burkhill at the Royal Botanic Garden, Kew, England, and will contain up-to-date information on some 4,000 plant species. Another extensive work is "Les Plantes Utiles du Gabon" by Walker and Sillans (1961), which describes each plant species together with its economic uses, ethnographic and artistic value.

In addition to this general literature of African economic botany, information on the uses of plants (and animals) can often be found in anthropological monographs on African tribes. Many of these do not give the scientific identifications of species concerned but some of the more recent publications do, for example Lee (1965, 1969); Scudder (1971, 1976); and Tanaka (1976). Reynolds (1966) gives the uses of around 200 plant species by the Tonga of Zambia. Whilst anthropologists have often tended to concentrate on the least "developed" tribal cultures, the literature of nutritionists does not suffer from this bias and is a further fruitful source of data on wild species as food. FAO has several relevant publications, such as Jardin's (1970) "List of Foods used in Africa" which gives the scientific names, edible part, geographical area of use and frequency of consumption of 4,000 items and extends to such rarities as batrachians, echinoderms, tunicates, ferns, lichens and algae, in addition to more usual food sources. An important discussion by Idusogie (1973), an African scientist, entitled "Centuries of changing food consumption patterns in African communities", draws attention to the great diversity of plants, fish and animals used as foodstuffs in Africa. As well as providing a great deal of food, wild plants are sometimes used as sources of water and salt in areas where these are naturally scarce (Portères, 1950).

The more specific field of the medicinal uses of plants in Africa has an impressive literature. Covering much of southern, central and eastern Africa is a 1,500-page volume by Watt and Breyer-Brandwijk (1962) which details uses in traditional and western medical practice. For Senegal, "La Pharmacopée Sénégalaise Traditionnelle" of Keharo and Adam (1974) contains very thorough scientific data on 550 species, illustrating what can be achieved by modern science based on traditional African knowledge. Similar works exist for several francophone countries and in Kenya, Kokwaro (1976) has recently produced "Medicinal Plants of East Africa". All this up-to-date literature demonstrates the enormous potential of African plants as drug sources, surely a fruitful field for future development.

The uses of plants as food for the domestic stock of pastoralists was not very thoroughly researched but is clearly an important aspect of the economic value of wild plants to man. Whilst there are some publications on the use of plant materials in the construction of houses, utensils and tools and in crafts (Table 2), much of it is of limited usefulness in a study of this kind because it fails to identify accurately the plants being used. This is surprisingly true of several recent books on African architecture. There appears to be only limited documentation on the uses of plants as fuel at a domestic level, although again this is clearly of considerable economic importance.

The use of animals as food in Africa is a subject of considerable interest, despite the difficulties in getting precise information. It is, moreover, an area of study in which African scientists are taking an increasing part and genuine African views on the vital subject are well represented among publications cited in the bibliography, e.g. Ajayi (1971, 1974, 1977) and Asibey (1966, 1969, 1971, 1972, 1974, 1976). A recent survey by de Vos (1978) of FAO shows just how widespread the use of animals for food is in Africa (Table 4) and this paper and those of Asibey and Jeffrey (1977) contain some useful quantitative data, particularly on the utilization of small and medium-sized mammals in West African

countries. While a good deal of the literature on the commercial possibilities of using African animals as food has concentrated on the larger mammals, this survey of existing domestic usage reveals the widespread importance of small mammals, such as rodents (den Hartog and de Vos, 1973), and invertebrates, especially insects. Apart from the eating of termites and caterpillars, honey is very widely consumed and probably constitutes the next most important animal product after mammalian meat and fish. Although there are many passing references to the use of fishes as food, there is a surprising dearth of detailed information on this valuable protein source in the documentation studied.

In summary, the overall impression gained is that almost all species of plants occurring in Africa are used by someone somewhere and many species, such as the Baobab, have a large number of regular uses, throughout their geographic range. The same is true of animals, for although some species are prohibited by custom, for certain classes there appears to be no universal pattern of taboos. What is forbidden to all but old women in one tribe may be regularly eaten by everyone in another tribe, and so on. Dr Thys of Brussels, an expert on African fishes, states that he only knows of one kind of fish that is not eaten anywhere in Africa: it is a highly poisonous species!

Any attempt to understand the importance of wild animals and plants in Africa concerning itself merely with their various uses and ignoring their cultural significance would be incomplete and naive. Indeed, it could be argued that the place of wildlife in Africa's art, philosophy and social organization is of much greater significance than its uses *per se*. Of course, the utilitarian and cultural aspects are closely interwoven, as many of the general anthropological and ethnographic accounts show. A recent article by Mankoto ma Mbaelele (1978) entitled "Part of African Culture", emphasized the importance of game utilization in the life and culture of African people. Of particular help in coming to grips with the specific part played by wildlife in African cultural and social patterns, are the recent works of the Department of Ethnozoology in Paris, under the leadership of M. Raymond Pujol (e.g. Bahuchet, 1972 and 1975; Levy-Luxereau, 1972). This group organized the first colloquium on ethnozoology, the proceedings of which, entitled "L'Homme et l'Animal" (Anon, 1975), contain a number of papers that exemplify the profound influence of the animals in their environment on the total thinking, language and life-style of African peoples. A book by Marks (1976) on the Bisa of Zambia, "Large Mammals and a Brave People", is another outstanding contribution to this area of knowledge. The importance of the plant resource to a section of the Kikuyu tribe is considered in admirable detail in a forthcoming book by Brokensha and Riley entitled, "Plants and People in Mbere, Kenya". All this recent work is ecological rather than anthropological in emphasis and marks a significant step forward in our understanding of man-wildlife interrelations.

2. Economic Importance

Some use of wild animals and plants is a traditional feature of the majority of African economies, irrespective of the primary means of subsistence. In order to lend perspective to the present study, a wide survey of the basic economy of 740 tribes in Africa and Madagascar was examined (Murdock, 1958), reflecting the situation prior to 1958. It was found that 614 tribes out of 740 had some dependence on wild resources. Table 1 presents the breakdown of this information. The data may be regarded as demonstrating the traditional relationship of the various peoples to their natural environment prior to the changes of the last twenty years - a relationship that is still deeply reflected in tribal cultures today, even though the degree of economic importance of some wild resources may have changed considerably since 1958.

TABLE I

A summary of information on the importance of wildlife in the basic economy of 740 tribes in Africa and Madagascar prior to 1958

Food Source	Gathering wild plant products			Hunting			Fishing			Honey	Shellfish	Insects	Guinea Fowl
Degree of importance in basic economy	Major	Considerable	Minor	Major	Considerable	Minor	Major	Considerable	Minor	(From wild or semi-wild bees)			(Semi-domesticated)
No. tribes out of 740	25	77	133	64	125	273	82	127	188	139	19	34	70
Totals	235			462			397						

It is worth noting from the figures in Table 1 that while relatively few tribal economies traditionally showed a "major" dependence on wildlife (171 instances), more than half gave some degree of importance to hunting (62%) and fishing (54%), and 32% to the gathering of wild plant products. It should be pointed out that tribes which do not have any major dependence on these forms of exploitation will have economies that are basically agricultural or pastoral, or a combination of the two. Perhaps the most obvious point to be made from this rather crude assessment is that the utilization of wildlife is basically acceptable to almost all African cultures and was a significant component of a large proportion of their basic economies, at least until relatively recent times.

In trying to arrive at a more precise assessment of the current economic importance of wildlife one must distinguish between the so-called "hunter-gatherers", who are a very small minority, and the great majority of tribes which are primarily agricultural or pastoral with, in some cases, a small urbanized component. The work of Tanaka (1976) on the San bushmen of the Central Kalahari shows that these hunting and gathering people are obliged to obtain their water from wild plants (and animals) for more than 300 days annually, melons and tubers being the main source.

Eighty-one per cent, by weight, of total diet is obtained from wild plants, 79 species of which are regarded as edible while some also provide medicine and material for tools. Over 50 species of wild animals are utilized and make up the other 19% of the diet. Clearly, such complete dependence on wild resources is not typical of modern Africa but rather serves to demonstrate the continuing feasibility of a subsistence economy similar to that of the earliest Africans (Idusogie, 1973).

The value of wild species in the economy of woodland savannah cultivators who also keep some domestic stock is illustrated by information on the Tonga people of the Zambia-Zimbabwe border. A list of their use of some 200 plant species is shown in Table 2. In addition, Scudder (1962) lists five plant species from which the Tonga extract salt. Clearly, in this primarily agricultural tribe there is very major use of wild plant products for construction, crafts and house building, as well as for dietary and medicinal purposes. Cultivation and subsidiary fishing practices are also dependent on the use of various woods for the manufacture of cultivating tools, boat transport and fishing gear.

Table 3 gives some indication of the relative importance of gathering (wild plants etc.), hunting and fishing to the mixed diet of the Tonga. In spite of considerable variation between localities in the degree of usage of gathered wild plants (possibly due to seasonal availability and varying degrees of acculturation between households), the figures demonstrate a surprising dependence on wild sources of vegetables for an agricultural economy. While the products of hunting and fishing make only a minor contribution to total diet, they constitute a major proportion of total animal protein (i.e. combination of animal husbandry, hunting and fishing) in two of the localities (Mazulu and Sitinkwe).

It is more difficult to assess the economic values attached to the medical use of plants but from the detailed information of Reynolds and Scudder it is clear that a great variety of ailments are definitely eased by either internal or external application of plant medicines. In other cases, materials originating from wild plants are essential to rituals connected with Tonga religious belief.

Thus in every vital aspect of their lives, these eastern Africa agriculturalists have a profound economic dependence on the wild resources of their savannah environment.

TABLE 2

Numbers of Plant Species Used for Various Purposes by the Tonga of the Gwembe Valley (compiled from Reynolds, 1966)

Uses	No. of Plant Species
1. Axes, adze and hoe handles	9
2. Construction of canoes	7
3. Ropes, knots and nets	15
4. House construction:	
Poles for both roof and walls	15
Poles for roofs only	5
Poles for walls only	10
Withes	12
Thatching grass	2
5. Food:	
Fruits and nuts	33
Vegetable relishes	30
Cooking aids and other edible plants	26
Oil-bearing plants	7
6. Medicinal and ritual purposes	49

A similar dependence on wildlife exists among people inhabiting the rain forests of central Africa. For example, the Lega of eastern Zaire, who practice a form of slash-and-burn shifting cultivation based on bananas, are reported by Biebuyck (1973) to have a "diet essentially of plantains and game meat, supplemented by a variety of tubers, grains, vegetables and fruits - some cultivated, some growing wild - by fish, occasionally by small quantities of chicken, mutton and goat meat, and by seasonal delicacies such as honey, termites and caterpillars". Although no actual quantities are given, it is clear that game meat is more important than that obtained from domestic stock. Biebuyck continues, "More than any other economic activities, hunting and trapping play a prominent part in Lega economy, ritual and thought. The rain forest offers an abundance and a wide variety of game... The Lega trap, hunt, or collect almost all species of animals found in their environment." A variety of fishing techniques is used including poisoning by means of the pounded leaves of a wild-growing liana. "Fish, particularly catfish, crab and mussels, are important ingredients in the diet of Lega groups

TABLE 3

Sources of Relishes (stews) Provided in Various Tonga Households in Three Different Locations in the Gwembe Valley. Information was Gathered Over Periods Ranging from 7 Days to 9 Months (after Scudder, 1962)

Relish source	Number of times relish provided in area		
	Mazulu	Bungola	Sitinkwe
Gathering	547 (77%)	48 (30%)	47 (57%)
Agriculture	106 (15%)	75 (48%)	33 (40%)
Animal husbandry	35 (5%)	31 (20%)	1 (1.2%)
Hunting	12 (1.7%)	4 (2.6%)	2 (2.4%)
Fishing	12 (1.7%)	0	0
Totals	712	158	83

that live in the proximity of the larger rivers..." In addition to wild fruits, plants and insects, building and construction materials are collected from the forest. The Lega also gather the fruit of *Lebrunia bushaie* and other trees for making cosmetic oils.

Hence it is clear that the wild animals and plants found in their forest environment are just as important to the economy of these cultivating people as other wild species are to the economy of savannah agriculturists. Such importance is not, however, confined to agriculturists. For example, the cattle-based Fulani of West Africa show very considerable dependence on wild resources and David (1976) lists more than twenty uses for 57 plant species found in and near settled Fulani villages in northern Cameroon (Appendix III). Some plants, such as the baobab tree, are used for a variety of purposes by the Fulani. *Acacia senegal* provides fodder for domestic stock, as well as glue; while the ashes of *Polygonum* are used as a salt substitute and several tree species furnish a cotton-like material used as mattress stuffing. Further north too, the nomadic Kel habitually harvest bush products (Bernus, 1967) and the pastoral Tuareg of the Sahara exploit the desert fauna for a wide variety of purposes including food, fodder and medicine for camels, and materials for their crafts (Nicholaisen, 1963).

It is thus abundantly evident that, whatever basic pattern of economy or ecological situation one considers in Africa, there is in almost every case a great dependence on wild resources. In many cases wild animals and plants are regularly and permanently utilized in an impressive variety of ways and to such a degree that loss of access to them would result in a complete collapse of the traditional economy. Even in economies where wild food is of secondary importance to that of domesticated sources, it often provides a vital component of diet or makes up for seasonal deficiency in the supply of cultivated products. There are also many economies where wild food supplies assume critical importance during times of drought and famine, wild animals or plants often being more resistant to disease or lack of water than domesticated varieties. For example, the FAO (1974) "Selected Bibliography on Food Habits: Socio-Economic Aspects of Food and Nutrition (Part I Tropical Africa)" contains many references to the use of wild animal or plant products as food during famine and stress on cultivated food supplies. A more specific example is provided by Gast's (1968) "Alimentation des Populations de l'Ahaggar", which gives details of the use of 90 wild plant species as famine food by the desert peoples of the Sahara. Insects such as the cricket and locust are also important during famine and, although fish are disliked, Gast states that they are occasionally eaten in times of famine.

TABLE 4

Terrestrial Wildlife as a Source of Food in Selected Countries of Africa

Country	Food consumption and Species Concerned
Botswana	The estimated consumption of game meat was 60% per person per annum for the country as a whole and for the Kalahari area 16.4 kg per person per annum.
	Over 50 species of wild animals, ranging from elephant through ungulates to rodents, bats and small birds provide animal protein exceeding 90.7 kg per person per annum in some areas and contribute some 40% of their diet.
	3.3 million kg of meat from springhare obtained by Botswana hunters.
Ethiopia	Mice and giant rats in the tropical western border area.
Ghana	About 75% of the population depends largely on traditional sources of protein supply, mainly wildlife, including fish, insects, caterpillars, maggots and snails.
	During the period Dec. 1968-June 1970 (17 months) a total of 157,809 kg of bushmeat from 13 species of animals was sold in Accra in one market only.
Ivory Coast	In the northern part of the country 27 g of bushmeat were consumed per person per day.
Morocco	Squirrel and porcupines are eaten.
Nigeria	19% of the locally produced food for the year 1965/66 was game consumed in rural areas.
	The Isoko tribe (Niger delta) obtain 20 g/day of animal protein, mainly game.
	Game constitutes about 20% of the mean annual consumption of animal protein by people in rural areas.
Rhodesia	Game yielded 5-10% more than the beef industry at a conservative estimate of 2.5 million kg.
	The Shoma people hunt and consume mice.
Senegal	A minimum consumption rate of 373,631 metric tons of wild mammals and birds per annum for the country's human population of 296,619.
South Africa	Thirty-eight species of wild mammals
Sudan	Rats and field mice are eaten.
Togo	Various species of wildlife, including rodents, are eaten. The per caput per day intake of rodents varies from 0.5-12 g.
Zaire	75% of animal protein comes from wild sources, including mainly three species of *Cephalophus* and three species of *Cercopithecus*. Rats and other rodents are also eaten.
Zambia	22% of those interviewed in the Serenji district reported having eaten small animals, including rats, mice and mole rats.

TABLE 5

Wild Animals of the Bushmeat Trade of Ghana
(listed in order of importance)

Damongo 1964/65 (Northern Guinea Savanna)	Techiman 1976/68 (Semi-deciduous Forest)	Accra 1968/69 (Coastal Plains Savanna)
1. Warthog	1. Baboon	1. Grasscutter
2. Baboon	2. Warthog	2. Giant Rat *(Cricetomys)*
3. Hartebeest	3. Grasscutter	3. Royal Antelope
4. Bushbuck	4. Hartebeest	4. Bushbuck
5. Crowned Duiker	5. Kob	5. Bat
6. Aardvark	6. Bushbuck	6. Green Monkey
7. Grasscutter	7. Roan Antelope	7. Crowned Duiker
8. Roan Antelope	8. Aardvark	8. Black Duiker
9. Buffalo	9. Waterbuck	9. Red River Hog
10. Waterbuck	10. Oribi	10. Monitor Lizard
11. Kob	11. Crowned Duiker	11. Togo Hare
12. Patas Monkey	12. Green Monkey	12. Mongoose
13. Crested Porcupine	13. Patas Monkey	13. Tree Hyrax
14. Oribi	14. Red-flanked Duiker	
15. Green Monkey	15. Crested Porcupine	
16. Colobus Monkey	16. Buffalo	
17. Crocodile	17. Red River Hog	
18. Reedbuck	18. Reedbuck	
19. Hunting Dog	19. Bay Duiker	
20. Giant Forest Hog	20. Colobus Monkey	
	21. Royal Antelope	
	22. Crocodile	
	23. Elephant	
	24. Genet Cat	
	25. Monitor Lizard	
	26. Hippopotamus	
	27. Puff Adder	
	28. Civet Cat	
	29. Yellow-backed Duiker	
	30. Tree Pangolin	

Quantitative information is not readily available on many forms of usage but there are some indications of the extent of the use of wild animals as food. Curry-Lindahl (1972) points out that 60-70% of animal protein in Liberia is from game; over 80% in Ghana. In Zaire 60% of the human population relies on bushmeat for its sustenance. In The Congo 50% of fresh meat is from game.

Two tables illustrate the variety, amount and value of meat from wild animals consumed in one West African country, Ghana. "Bushmeat" is of great importance in many West African countries and is often preferred to the meat of domestic stock, fetching higher prices than the latter. This is leading to over-exploitation for food and is having a detrimental effect on the conservation of some animal species. (Table 5 from Asibey, 1971: Table 6 from Asibey, 1974).

From Table 4, taken from de Vos (1978), Botswana, Ghana and Zaire stand out as three countries which, in spite of belonging to different ecological zones of Africa and having differing national economies, show a remarkably high dependence on wildlife as a source of animal protein. Most of the detailed information on wildlife consumption available for Ghana is a result of the very active promotion of wildlife utilization by Dr E.O.A. Asibey, formerly Chief Game and Wildlife Officer of the Ghana Government and now Chairman of the Forestry Commission. In Table 5, Asibey lists the wild animals consumed as "bushmeat" in three ecologically distinct areas of the country, illustrating the great variety of animals utilized in this way in a typical West African state. A notable feature of these lists is the inclusion of primates and smaller mammals, such as grasscutter (cane rat) and giant rat, high in the orders of priority. Carnivores such as civet, mongoose and hunting dog are also included, although apparently less favoured, possibly because they are more difficult to obtain. Some indication of amounts consumed and values can be gained from Table 6 (from Asibey, 1974). In Liberia, antelopes (mainly duiker) and various species of monkey are the most popular and, unlike some countries, are less expensive than domestic meat, as recent prices from Jeffrey (1977) indicate - see Table 7. It is not surprising that the popularity of bushmeat is having a detrimental effect on the conservation of some wild animal species in a number of West African countries.

The economic importance of bushmeat in Nigeria is emphasized by Dr Sunday S. Ajayi of the University of Ibadan, Nigeria, a campaigner for the rationalization of this form of wildlife utilization. He estimates (Ajayi, 1971) that in some rural areas 20% of the animal protein consumed is from wild sources and that 80% of the southern population eat bushmeat. He calculates that annual value of wild animal protein (inclusive of bushmeat, wildfowl, and fish) in Nigeria totals some £30 million which is approximately equivalent to 4% of Nigeria's Gross Domestic Product. Such figures leave little doubt as to the economic value of wildlife as food in the highly populated countries of West Africa.

TABLE 6

Bushmeat Record for Kantamanto Market (Accra, Ghana)
Period December 1968 - June 1970

Species	Weight in kg	Price in US $
Grass-cutter (*Thryonomys* spp.)	117,226	125,181.27
Grey Duiker (*Sylvicapra grimmia*)	26,406	23,280.00
Bushbuck (*Tragelaphus scriptus*)	4,225	2,808.00
Royal Antelope (*Neotragus pygmaeus*)	3,682	3,596.40
Black Duiker (*Cephalophus niger*)	3,498	2,758.90
Green Monkey (*Cercopithecus aethiops*)	1,055	836.30
Bay Duiker (*Cephalophus dorsalis*)	701	603.50
Bushpig (*Potamochoerus porcus*)	561	320.00
Brush-tailed Porcupine (*Athearus africanus*)	357	424.80
Giant Rat (*Cricetomys gambianus*)	121	61.50
Monitor lizards (*Varanus* spp.)	92	61.40
Two-spotted Palm-civet (*Nandinia binotata*)	47	37.50
Togo Hare (*Lepus capensis*)	8	8.30
	Total	159,985.87

TABLE 7

A 1977 Comparison of the Average Costs of Bushmeat with Domestic Meat,
Outside Monrovia, in Liberia (from Jeffrey, 1977)

Type of bush meat	Average price per lb.
Antelope carcass	$ 0.20
Butchered antelope	$ 0.33
Smoked antelope	$ 1.39
Monkey carcass	$ 0.19
Butchered monkey	$ 0.27
Smoked monkey	$ 0.79
Type of domestic meat	**Price range per lb.**
Beef	$ 0.50 - $ 1.00
Pork	$ 0.60 - $ 1.25
Salt pork	$ 0.85 - $ 1.25
Sheep or goat	$ 1.00 - $ 1.50

However, from Botswana, figures on the economic value of local hunting indicate the possibilities for wild animal exploitation at a local level in a less heavily populated country of southern Africa. It is estimated that 9,144,360 kg of game meat, obtained through local hunting, is eaten annually in Botswana. This has enabled the country to export US$2,520,000 worth of beef (to obtain foreign exchange) that would have been eaten locally had game meat not been available. The export of game skins and hides represents US$280,000 in annual income to village hunters and the export duty on these products is $42,000 annually to the Botswana Government (de Vos & Kaittany, 1972). Wildlife is relatively plentiful in many countries in eastern and southern Africa but its exploitation is often viewed as the prerogative of large-scale government-controlled enterprises, with high capital investment. Botswana has demonstrated the value of low-level utilization by local people, with an operation which is a natural extension of exploitation for their own domestic needs. A similar possiblity is discussed with reference to tree hyrax skins and meat in the Kilimanjaro region of Tanzania by Kundaeli (1976). Local trappers were paid T.sh 1.60 per raw skin, providing a useful income from this small forest mammal while the trappers consumed or sold the carcass to nearby farm labourers at T. sh 1.00. The Botswana figures also draw attention to the economic value of skins as an important by-product of animals killed for meat. Afolabi Ojo (1966), in discussing Yoruba "industries dependent on animals", states that in Nigeria the leather of wild species is of more value than that of domestic species and is used for clothes, mats, sandals and bags. Similar uses have been described for numerous other tribes. Besides meat and skins, other commercially valuable products such as carcass and bone meal (for fertilizers) and trophies (ivory, horn, etc.) add appreciably to the economic value.

Although not systematically arranged, these data on the numbers and prices of animal products that are sold for cash in various parts of Africa give a fairly good indication of economic value.

TABLE 8

Chemical Composition of Five Major Wild Food Plants of the San (Botswana and Namibia [South West Africa]) Compared with Peanuts and Brown Rice (Yellen and Lee, 1976). Many Such Analyses are Available For Both Wild Plant and Animal Foods, Showing Favourable Comparisons with Similar Domesticated Varieties in Most Cases

Common name	Mongongo nut	fruit	Baobab fruit & nut	Tsin bean	Veg ivory fruit	Grewia berry	Peanuts roasted w/skins	Brown rice cooked
Botanical name	*Ricinodendron rautaneii*		*Adansonia digitata*	*Bauhinia esculenta*	*Hyphaene ventricosa*	*Grewia retinervis*	*Arachis hypogaea*	*Oryza sativa*
Season of use	All year	Apr-Nov	May-Sept	Feb-July	June-Oct	March-June	-	-
Composition in g/110g eaten								
Moisture	4.2	13.4	5.2	5.2	6.6	10.6	1.8	70.3
Ash	4.0	5.7	7.3	2.9	9.0	3.7	2.7	1.1
Protein	28.3	6.6	14.3	31.6	4.9	5.4	26.2	2.5
Fat	58.4	0.6	13.9	31.6	0.4	0.2	48.7	0.6
Fibre	1.5	3.5	10.7	1.0	9.6	12.6	2.7	0.3
Carbohydrates	3.7	70.2	51.4	23.2	69.6	67.5	20.6	25.5
K calories	654	312	388	544	302	293	582	119
Composition in mg/100g eaten								
Ca	249	89.6	272	136	103	157	72	12
Mg	500	195	630	258	196.5	172	-	-
Fe	2.07	0.74	9.51	3.3	2.04	4.7	2.2	0.5
Cu	1.90	0.45	2.47	1.0	0.47	0.4	-	-
Na	2.0	1.01	76.3	89.0	544.9	31.0	5	282
K	686.6	1760	4173	849	2560	655	701	70
P	704	46.0	1160	484	155.8	-	407	73
Zn	4.09	1.39	6.96	3.8	0.56	1.6	-	-
B-Carotene	-	0	-	0.22	0.06	-	-	-
Thiamin	0.127	-	-	0.936	-	-	0.32	0.09
Riboflavin	0.139	0.113	-	0.815	0.096	-	0.13	0.02
Nicotinic Acid	-	0.121	-	1.86	4.62	-	17.1	1.4
Vitamin C	0.57	8.51	-	2.19	19.7	-	0	0

3. Nutritional Value

There is a surprising amount of good data on the nutritional value of many African wild species used as food, making objective comparisions with domesticated foodstuffs possible. The "Food Composition Table for Use in Africa" published by FAO (1968) contains full nutritional analyses of 1,600 plant and animal species, many of which are wild. Together with Jardin's (1970) "List of Foods Used in Africa", also published by FAO, this document demonstrates a significant recognition of the usefulness of hundreds of wild species as human food throughout Africa.

As an example of the kind of comparison which available analyses enable us to make, Table 8 shows the chemical composition of peanuts and brown rice and five major wild food plants of the San of Botswana and Namibia (Southwest Africa) (from Yellen and Lee, 1976). Wild mongongo nuts are a primary food of the San and, as the table shows, are high in protein and have a higher fat content and more K-calories than any of the other foods shown, including peanuts. The Tsin bean, *Bauhinia esculenta*, a widely eaten wild plant, also compares favourably, with a particularly high protein content. Baobab fruits and nuts are also eaten throughout Africa and, although of only average calorific value, are remarkably high in minerals including calcium, potassium and phosphorus. All the wild foods listed are greatly superior to brown rice in almost all important nutritional attributes, demonstrating the point that Africa's own native food supply provides better quality for its human population than many imported foods.

Further information on the nutritional value of wild plant foods is given in Table 9 (from Scudder, 1962), in which analyses of wild leaf relishes eaten by the Tonga show these to be important sources of minerals and two of them to contain appreciable amounts of protein.

Additionally, many African fruits are an important source of ascorbic acid (Vitamin C), the lack of which causes diseases such as scurvy and delays the healing of wounds. Analysis of 10 fruits, many of them eaten throughout Africa, are shown in Table 10. Several of these fruits are also a useful source of sugars.

An unusual source of plant protein is a species of blue-green alga (*Spirulina plantensis*) found in alkaline inland waters. For many generations this alga has been eaten in the Lake Chad area. After allowing water to drain away, the collected residue is dried in the sun and then cut into blocks which are cooked and eaten as a green vegetable. Some 60-70% (dry weight) of *Spriulina* is good quality protein and it is also rich in vitamins, particularly B_{12}. Digestibility in rats in 84% and net protein utilization 61%. The possibility of culturing the alga in artificial basins and using it as an additive to cereals and other food products has recently been researched. (Anon. 1975. Under-exploited Tropical Plants with Promising Economic Value, National Academy of Sciences, Washington, D.C.)

TABLE 9

Analyses of Three Leaf Relishes Eaten by the Tonga of Zambia (from Scudder, 1962)

Wild plant source of relish	Crude fat %	Protein (Nx 6.25) %	Carbo-hydrate (by diff-erence) %	Crude fibre %	Ash %	Salt as Nacl %	Calcium as Ca mg/100g	Phos-phorus as P mg/100g	Iron as Fe mg/100g
Corchorus tridens	4.2	12.3	45.5	8.3	29.7	12.5	1,320	2,125	34
Gynandropsis gynandra	7.6	31.2	36.9	9.9	14.4	5.1	1,007	700	25
Amaranthus thunbergii	6.1	25.7	37.3	8.5	22.4	8.3	3,270	400	11

TABLE 10

Ascorbic Acid and Mean Sugar Content of 10 Edible Wild Fruits (from Scudder, 1962)

	Edible Portion %	Analysis Sample	Mean Moisture %	Mean Invert Sugar %	Sugar as Sucrose %	Ascorbic Acid Content Aver.	Min. mg/100g	Max.
Adansonia digitata	-	-	10-13.1	-	-	310	175	445
Sclerocarya birrea	30	edible portion (ripe)	87	2.3	5.9	179.1	62	254
Phyllogeiton discolor	-	whole fruit	72.5	18.8	0	87	-	-
Cordyla africana	45	pulp and seeds	80.9	trace	0	75.6	-	-
Ximenia caffra	49	whole fruit	66.4	trace	0	49.6	24.8	68.4
Strychnos innocua	40.5	edible portion (ripe)	70.6	7.2	7.4	14.4	-	-
Ficus sp.	100	whole fruit	85	6.3	0	trace		
Azanza garckeana	85	edible portion (ripe)	18	36.8	2.6	0		
Tamarindus indica	64	pulp and seeds	20.7	19.4	0.4	0		
Vangueria tomentosa	100	whole fruit	53.1	10.2	0	0		

TABLE 11

Average Daily Consumption of Total Animal Foodstuffs and Amount of Protein Provided in the Diet of Isoko Farmers of the Niger Delta, Nigeria (from de Vos, 1978)

Food	Edible portion in grammes	Protein content in grammes
Fish (fresh)	18	3.0
(dried)	18	9.0
Monkey (fresh)	8	1.2
(dried)	7	3.2
Goat	6	1.0
Pangolin and porcupine	5	0.9
Grass-cutter and giant rat	3	0.6
African snail	3	0.6
Palm weevils	1	0.1
Frogs	3	0.6

Total animal protein 20.2
(Total vegetable protein) (26.1)

Acacia albida is a tree which is widely used as a fodder plant all over Africa, both foliage and pods being fed to camels, cattle, sheep and goats. Its seeds are used by people as a famine food in some areas, being particularly high in protein (27%), and the leaves and pods (13-17%) compare well with many other plant sources. The nutritional value does not deteriorate on drying and in the Sudan it has been calculated that in one season twelve trees yield 200 kg of crude protein (pods alone), comparing favourably with 180 kg from a crop of unshelled groundnuts. Similar analyses show many African trees used as fodder for domestic stock to have a high protein content.

Numerous papers by African scientists testify to the importance of wild animals and fish as a protein source (Ajayi, 1971 and 1977; Asibey, 1966, 1972 and 1974; Idusogie, 1973; Orraca-Tetteh, 1963), some indicating that bushmeat often has a higher nutritional value than domestic meat (Asibey and Eyeson, 1975). Table 11 shows the contribution of a variety of wild animals and goat to the average daily consumption of animal protein by Isoko farmers of the Niger Delta, Nigeria. As much as 81% is

TABLE 12

The Chemical Score of Meat from Various Wild and Domestic Animal Species (new FAO reference protein) (From den Hartog and de Vos, 1973)

Food	Chemical Score	Food	Chemical Score
Beef and veal (*Bos taurus*)	94	Elephant (*Loxondota*)	112
Chicken (*Gallas gallus*)	91	Zebra (*Equus* sp.)	78
Rat (*Rattus* sp.)	83	Wildebeest (*Connochaetes*)	88
Caterpillar (*Bombycomorpha* sp.)	89		

provided by fish and monkey meat alone and only 1% by goat meat, the rest being made up by a variety of wild species including several invertebrates.

The chemical score of the meat of five wild species is compared with beef and chicken in Table 12. On this basis elephant meat shows up best of all, with wildebeest and a caterpillar comparing favourably with the domestic products. Even the common rat scores creditably, reminding us of the fact that rodents are an important item in the diet of many African people. Asibey and Ajayi have done considerable research on the suitability of the cane rat (grass-cutter) and giant rat, respectively, as candidates for domestication. Ajayi (1977) pointed out that giant rat meat has a low fat and high protein content and a dressing-out percentage (51.5%) that compares with domesticated species bred for meat. The same holds true for almost all wild mammals investigated for their meat production potential.

Another very valuable source of protein, widely available across the continent, is the giant African land snail, of the genus *Achatina*. It is eaten on a large scale in West Africa and is immensely popular with people of the central region of Ghana and parts of Nigeria. Orraca-Tetteh (1963) has carried out a very thorough investigation of its nutritional qualities and found that a fresh sample of the edible portion is 74% protein (dry weight basis) or 16.4% net weight. This compares well with a range of 16-19% for beef. Snail meat contains a considerably greater percentage of certain amino acids, notably arginine and lysine, than whole chicken's egg. The snail grows readily under natural conditions and appears to possess a number of characteristics that make it suitable for culturing.

Termites (white ants) are also widely eaten seasonally in many areas and analyses show them to be unusually high in both protein (36%) and fat (44%), thus corroborating the considerable esteem accorded to them by some tribes (Tihon, 1946).

The wealth of scientific evidence for the high nutritive value of a large number of wild food sources in Africa appears to call for justification of the high bills for the importation of foreign foodstuffs by some countries. For example, Idusogie (1973) gives the following figures for total annual value of food imports: Nigeria (1965) £ 24 million; Ghana (1968) C 60 million; Lesotho (1971) R 2,714,000. Obviously there is a strong case for thorough investigations into the possibility of rationalizing the utilization of some of the wild sources indicated by existing documentation. In some cases more efficient harvesting of a carefully conserved wild resource is suggested, while in others there would appear to be grounds for considering domestication or some form of culture. There appears to be very considerable nutritional potential in both wild plants and animals in Africa.

4. Medicinal Importance

Many authors appear to find it difficult to separate genuine African medicine from cultural and religious practices and one often finds all-inclusive categories in the literature, such as the "medicinal and ritual purposes" of Table 2. Indeed, one might argue that as long as a clearly beneficial effect can be demonstrated from the application of a particular potion in prescribed circumstances, the point as to whether it acts in a psychosomatic manner or by more easily understood physiological pathways should not influence its classification as "medicine". As Idusogie (1973) points out, the scientific basis of many African cures based on wild plant or animal products is quite clear, although in other cases it remains to be established. From the point of view of the present report the only point at issue would be whether an established use is considered under the heading of "medicine" or "cultural significance". Because the standpoint of this study is primarily one of usage (of some kind), no attempt has been made to resolve these difficulties of definition. What is ultimately important is that Africa herself currently recognizes enormous numbers of plants and some animal products to be of curative value in physical and mental illness. It is perhaps significant that in Table 2 more plant species (49) are listed as being used for medicinal and ritual purposes by the Tonga than for any other single use category.

Table 13 is taken from a very thorough and objective study of the use of plant medicines by the Hausa of the Republic of Niger (Adam, Echard and Lescot, 1972). It demonstrates a great number of medicinal uses, five of the plant families listed having more than thirty uses ascribed to them by this particular tribe. The authors describe the botanical aspects, preparation, therapeutics and form of utilization of this long list of plant species. An outstanding example of the application of modern science to traditional African medicine is provided by a recent traditional pharmacopeoea for

TABLE 13

List of Plant Families Containing Species Used for Medicinal Purposes by the Hausa of Ader, Niger. Families are Arranged in Order of Frequency of Utilization of Species Contained Within Them (from Adam, Echard and Lescot, 1972).

Number of Families	Number of Species Cited	Medical Uses
Capparidaceae	7	65
Minosaceae	10	51
Combretaceae	5	45
Caesalpiniaceae	9	40
Papilionaceae	11	37
Anacardiaceae	2	28
Euphorbiaceae	5	28
Asclepiadaceae	4	18
Tiliaceae	4	17
Acanthaceae	4	16
Annonaceae	1	15
Olacaceae	1	15
Polygalaceae	1	15
Simarubaceae	1	15
Zygophyllaceae	1	15
Malvaceae	4	14
Rubiaceae	5	14
Cucurbitaceae	5	13
Loranthaceae	1	10
Rhamnaceae		9
Sterculiaceae	1	8
Bignoniaceae	1	6
Burseraceae	1	6
Solanaceae	2	6
Compositeae	2	5
Onagraceae	1	5
Cochlospermaceae	1	4
Gramineae	4	4
Lythraceae	1	4
Moroceae	4	4
Pedaliaceae	2	4
Ulmaceae	1	4
Amaranthaceae	1	3
Convolvulaceae	3	3
Amaryllidaceae	1	2
Boraginaceae	1	2
Labiateae	1	2
Arecaceae	1	1
Caryophyllaceae	1	1
Commelinaceae	1	1
Elatinaceae	1	1
Meliaceae	1	1
Verbenaceae	1	1

Senegal (Keharo and Adam, 1974). This large volume provides a very thorough scientific analysis of the therapeutic uses and chemistry of 550 plant species, used in Senegal and surrounding countries of West Africa. Similarly, the current local use, use in modern medicine, physiological effects and active chemical principles of an enormous number of plants in southern and eastern African are described in the 150-page work of Watt and Breyer-Brandwijk (1962).

It is clear that certain of the active principles forming the basis of traditional African cures are the same chemicals that are employed in the drugs of modern medicine. Moreover, it is likely that some medicines, based on wild plant or animal products, when fully analysed will yield fresh insights for clinical medicine and form the basis of new drugs for the benefit of all mankind. There are a number of research institutes in Africa, such as the Drug Research Institute at Ife, Nigeria and the Centre for Scientific Research into Plant Medicine in Ghana, which have this end in view.

The antiquity of medical remedies derived from plants and animals is illustrated by Strelcyn's (1966, 1968, etc.) translations into French of old Ethiopian papers on traditional medicine. Some of these were written in Geez, the classical language of Ethiopia, and date from the seventeenth century (Strelcyn, personal communication). There is no doubt that the use of wild resources for medicine is as old as their utilization for food and continues to be equally important today.

Thus, from whatever perspective one views African medicine there is no denying its actual and potential importance and since it is almost wholly based on remedies originating from wild plant and animal species, it must be considered as a form of utilization, the continuing availability of which needs to be ensured.

5. Social and Cultural Significance

Much of what has been discussed above under the economic, nutritional and medicinal use of wild fauna and flora is in reality part of culture, which, although being considered last, is the most important and over-riding aspect of human-wild life interrelations. Philosophy, language, art, religion and the social structure itself are all deeply influenced by man's association with the wild. For instance, Biebuyck (1973) writes of the Lega (see bibliography for country) that game meat, besides being a substantial part of their diet, is of extreme importance in feasts and exchanges connected with initiations. The durable parts (hides, teeth, scales, carapaces, claws, nails, tails, bones, tusks and shells) of many wild species are used in large quantities as adornments, initiation objects, and status and prestige symbols. Animal actors and hunting scenery abound in the oral literature of the Lega. Similitudes, metaphors and identifications drawn from the animal world fill the teachings that are given during circumcision rites and initiation ceremonies. Much of this would still be true for hundreds of other tribes across Africa and is elaborated upon at great length in literature on tribal customs and culture. Throughout the world a people's environment has a dominating influence on their cultural development and it is not surprising that Africa's abundant wealth of fauna and flora is profoundly reflected in the thinking, organization and expression of its human inhabitants.

The Fali of the Cameroons provide us with an example of how traditional cosmology in Africa views man in relation to the rest of the created order (Lebeuf, 1961). He is seen as a microcosm in perfect balance with the macrocosm that constitutes the universe. In accordance with this, the parts that go to make up a man's body are regarded as corresponding to a component of each of the major domains of his environment, i.e., mankind, heat, water, earth and air. Of the latter four, two are viewed as having male associations and two as female: also carefully in balance.

In the detailed scheme of things (Table 14) water is represented by a variety of fishes, earth by wild mammals and air by birds, illustrating how the Fali view wild species as integral parts of their respective environments. If more cultures held such an ecologically sound view of the universe there would be far fewer ecological problems. It is precisely because many "modern" people fail to appreciate the incongruity of water without fish, earth without mammals (and other animals) and air without birds that there is so much imbalance and destruction of natural resources in many countries. Without their natural flora and fauna many habitats tend to become unproductive and desolate. And, as

TABLE 14

According to Lebeuf (1961) the Fali of the Cameroons view man as a microcosm in perfect balance with the macrocosm that constitutes the universe. Accordingly, each part of a man's body is seen as corresponding to a member of one's family, edible seeds, a fish, a wild mammal and a bird. The example illustrates the great importance of wild animals in the cosmology of many African cultures.

Human Body	Family	Edible Seeds	Fishes	Wild Mammals	Birds
Head	patriarch	red millet	kiti - Nile perch	Sable antelope	marabou stork
Chest	father	water melon	tere	hartebeest	sparrow hawk
Stomach	mother's brother	"house millet"	tanje	warthog	vulture
Right arm	father's brother	haricot bean	tawatiti	waterbuck	kite
Left arm	first spouse	peanut	ranu - *Clarias*	Buffon's kob	hornbill
Legs	second spouse	wild melon	fero - *Hemichromis*	reedbuck	crow
Vulva	third spouse	early millet	tabenga - carp	bat-eared fox	stork
Buttocks	fourth spouse	white ground pea	takoga - *Synodontis*	oribi	owl
Anus	eldest son	red ground pear	taonteon - *Synodontis*	gazelle	falcon
Nose	eldest daughter	black sesame	voluma - *Malopterurus Electricus* (G.)	monkey	turtle-dove
Ears	other sons	white sesame	tabiji - little white fish	hare	hammerkop
Eyes	other daughters	"hen's eyes" sesame	laku - *Hyperopisus*	palm rat	crowned crane
	MANKIND	HEAT ♂	WATER ♀	EARTH ♀	AIR ♂

the Fali correctly perceive, a man's own well-being as an individual and his relationship with his fellows is related to the maintenance of an essential balance between mankind and the plants and animals that are part and parcel of his universe. Man and wildlife are interdependent.

The part played by wildlife in linguistics and the development of languages is also highly significant. For example, the vernacular name for an animal frequently indicates an intimate knowledge of its ecology or behaviour on the part of the users of the vernacular. Other names indicate some form of association with man. Thus "nyama" is the Kiswahili (East African) general word for animals and also the word for meat which man derives from many of them. Similarly, in a number of Central African languages the word for tree and that for medicine are the same, indicating the medicinal importance of many tree species. A number of studies of the importance of animals and plants in linguistics have been published by French scholars such as a recent consideration of animals in Hausa lexicology by Gouffe (1975).

A parallel area of study is the part played by animals in African art (Ben Amos, 1975), where in the fields of painting, design and sculpture many artists draw extensively on the animal world for basic ideas and motifs. Like language, much art reflects the forces at work in the real lives of people and it is not surprising that wild species figure prominently in much authentically African artist expression. In addition to their contribution to the conceptual basis of art, plant and animal products are frequently used in its execution. For carving, many types of wood are used and in some countries the popularity and excellence of this art form have resulted in it becoming almost a commercial operation. In Nigeria, decorated gourds are a distinctive art form in which many fish and animal motifs are used to decorate the gourds which are, of course, of plant origin. Plant, and some animal dyes are widely used for dying cloth of cotton, silk or wool, bark cloth, raphia and leather (White, 1974), and provide a further illustration of the use of wildlife products in crafts. In music too they play an important part, wood, skin or horn forming the basis of most musical instruments. The famous xylophones of Uganda and Zaire are made only from certain species of tree and, of course, drums of various kinds are widely used for entertainment and ceremony. Many songs contain information on wild animal and plant life.

An illuminating paper by Levy-Luxereau (1972) on the Hausa of The Republic of Niger contains a detailed analysis of how animal products are used in the cultural life of this tribe. The paper describes the use of 181 animal-based "remedies" in relation to six basic components of Hausa living (see Figure 1). Whether one views the uses of the remedies as genuine medicine, religion or "magic" does not detract from the fact of the remedies or that the six aspects of human existence to which they are applied are real and important. Their relative importance within the Hausa philosophy-of-life is suggested by the number of remedies available in each category.

Thus, the greatest number of medicines (49) is applied to ills arising in the area of social competition. (As in many cultures, one's relationship with ones fellow human beings ranks above such matters as physical well-being or the acquisition of material wealth). The achievement of the norms of Hausa life-style is firmly believed to be assisted by the application of a great variety of animal-based concoc-

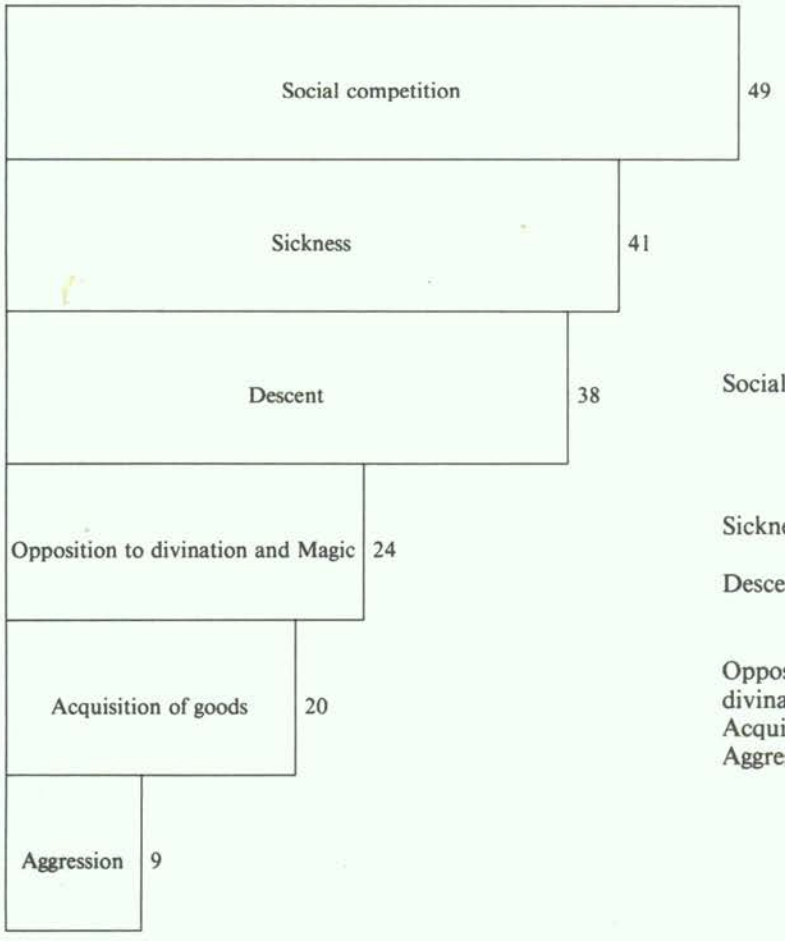
tions. Thus in such a society animals play a vital role in practices which bridge the gap between philosophical belief and its practical manifestation in everyday life.

Economic dependence on wild resources produces a close relationship between the way of life and social organization of many tribes and the ecological factors governing the existence of wildlife. For example, the seasonal rhythm of the bush or forest is often reflected in the cyclical nature of activities such as gathering, hunting and fishing. Bahuchet (1972, 1975a & b) has made a penetrating study of such interactions in the Babinga people of the Central African Republic. In Figure 2, he summarizes diagramatically the central importance of game in the Babinga socio-economic system (from Bahuchet, 1975). Techniques of game capture vary seasonally between trapping and hunting, which may either be carried out on an individual basis or as a cooperative exercise using nets. This latter method, used in the dry season, necessitates the grouping together of the three or four Babinga encampments, thus seasonally influencing group composition, social rapport and material exchange. Game products such as meat, skins and ivory are partly used by the hunter(s), e.g. as food, partly shared out within the encampment and partly used for exchange with outsiders. Clearly, sharing has an important effect on cohesion and equilibrium within the group, and in turn on the success of their cooperative hunting efforts. Exchange is of two types. Young men prove their worth on prolonged visits to prospective parents-in-law by presenting them with the fruits of their hunting and a final dowry is frequently paid in game meat. A poor hunter will have difficulty in a group, so that marriage (and divorce) and premarital visiting both affect alteration of group composition. The other type of exchange involves bartering game products for tools and weaponry, such as guns and ammunition, with adjacent tribes. The efficiency of hunting will depend in part on successful bartering of this kind.

In this central African socio-economic system one can readily see the fundamental importance of the wild animal resource to the intricate web of human relationships and activities that is built up around it. It is a true example of a "wildlife culture", many variations of which occur throughout tropical Africa even today. In some cases the relationship with a single type of wild resource is not so polarized as in this example but nevertheless wildlife resources still play a significant role in the great majority of African cultures. There are many examples where a former economic dependence on hunting is merely reflected today in the presence of hunting as a recreational activity. But even this form of interaction with wildlife plays a significant role as a social factor. As indicated earlier, even in urbanized communities game meat is highly sought after, particularly in West Africa where there has generally been less disruption of basic cultural patterns than in some countries in the eastern and southern parts of the continent. Analysis of any robust culture, from whatever part of Africa, frequently reveals wild animals and plants to be making a fundamental contribution to its philosophical, linguistic, artistic and social components. Indeed, Africa cannot retain its rich cultural identity unless it preserves its wealth of wild fauna and flora. The destiny of its people cannot be separated from the future of their environment.

FIGURE 1

Animals are widely used in the medical and religious practices of the Hausa of Niger Republic. The diagram below shows the number of animal-based remedies used in relation to each of six basic categories of Hausa existence (from Levy-Luxereau, 1972). The total of 181 animal "medicines" is an indication of the great importance of animals in the everyday lives of these people at the present time.



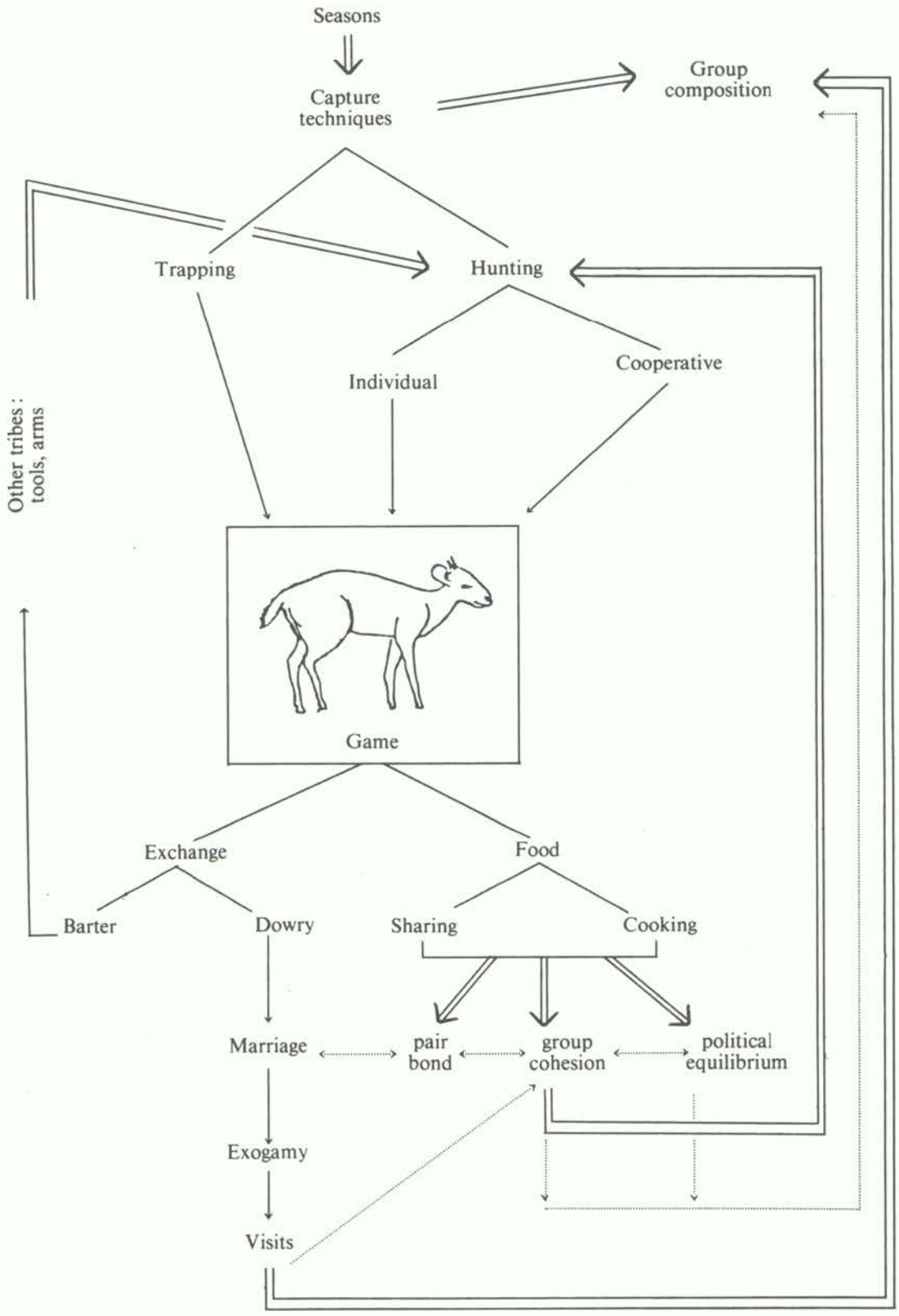
Explanation of categories

Social competition:	attainment of qualities (respect, intelligence, power, seduction, being ahead etc.) and protection from evil (misfortunes, desertion by spouse, adultery etc.)
Sickness:	to recover or be protected from physical or mental illness
Descent:	protection of infants from illness, healing of sexual impotence, female sterility
Opposition to divination and magic:	to be forewarned against these actions
Acquisition of goods:	crops, money, game etc.
Aggression:	assaults against fellow-men.

FIGURE 2

Diagram illustrating the central importance of hunting to the socio-economic system of the Babinga of the Central African Republic (Bahuchet, 1975). Capture techniques influence the composition and degree of cooperation of hunting groups. Games products are distributed as food within and between such groups (influencing intra-group cohesion and inter-group relationships), used as property in exchanges (e.g. in connection with marriage) and for bartering for tools and weapons with other tribes.

Seasonal variations in the types and amount of game available are responsible for fluctuations in the various chains of interactions within this animal-based socio-economic system.



III. THE FUTURE OF THE WILDLIFE RESOURCES

It is of paramount importance that the significance and values which Africa traditionally accords to its fauna and flora be maintained. In purely economic terms, wildlife is an enormously valuable renewable resource and ranks among the continent's most important assets. In an area which has a rapidly growing human population and is short of materials, foodstuffs and medicines, it is unthinkable that the diverse potential of wild animals and plants is not conserved and developed to its fullest possible extent. But over and above these utilitarian aspects, the priceless cultural inheritance that Africa's wild species represent cannot be allowed to disappear but must be carefully guarded, not in the sense of a museum curiosity but as the source of a valued continuing input into the forward movement of a dynamic culture. It is thus vital that Africa itself gives urgent consideration to the matter of ensuring continued utilization of its wildlife. It is a matter of some concern that while the economic and nutritional importance of wildlife is receiving good attention from African scientists, there seems less evidence of an appreciation of its contribution to indigenous culture. Until wildlife is viewed alongside art, language and music as part of Africa's soul which must be preserved and developed at all costs, it will remain in danger of extinction by over-exploitation or neglect. It follows that those who are concerned about the disappearance of Africa's fauna and flora must first and foremost strive for a correction of attitudes and values. Causes of wrong attitudes must be sought out and eliminated, the aim being to produce a balanced, wholesome approach that is entirely proper to African philosophy and in accord with its best traditions. However, present causes of imbalance are not uniform across the continent.

1. Counter-productive Legislation

It is unfortunate that wildlife conservation, particularly in southern, central and eastern Africa, has hitherto largely been associated with the colonial and post-colonial enterprises of foreigners. In many countries colonial governments introduced strict laws forbidding traditional forms of wildlife utilization which were branded as "poaching". At the same time foreigners were encouraged to hunt, photograph or simply look at the wild creatures or export them to zoos in their own countries. Even today most of these laws still exist and any subsistence utilization, particularly of wild animals, has to be carried on in opposition to the law. It is characteristic of certain legislation that insufficient provision was made for the continuance of perfectly harmless patterns of traditional activity of great significance to tribal economy and culture. In the case of game laws, there sometimes appears to have been inadequate assessment of the effect of subsistence hunting on wild animal populations. Indications are that in many cases there were built-in feedback mechanisms that prevented excessive exploitation, particularly prior to the advent of modern firearms. For example, in some tribes a hunt is always abandoned if the game is not sighted within a certain distance from the village, this being indicative of low game numbers in the area.

The considerable social and recreational importance of local hunting also appears to have been either overlooked or ignored. Clearly, greed and all forms of potentially excessive off-take, including commercial ventures, need to be controlled in order to conserve a resource but legislation which outlaws a self-regulatory harvesting process of great benefit to those involved is insensitive. That most of the wildlife legislation is not in the long-term interests of conservation is sometimes evidenced by the negative attitudes to the resource it has produced in former "careful users".

Profits need to be fairly high in order to induce many hunters to take the risk of being caught and so it is that much poaching today is not for subsistence necessity but is really a business exercise with substantial commercial gain involved. Moreover, some exploiters have little sense of stewardship toward wild animals because wildlife is not a resource on which they basically rely but it is rather an item of commerce to be turned into money as quickly as possible. Its strong association with foreigners has encouraged people to forget that it is a unique African heritage, of long and deep involvement with their own way of life and culture.

There is a distinctly different attitude to wild plants which are not subject to legislation and are still harvested on a non-commercial basis for local consumption. It is the view of the author of this report that more and stricter legislation is not ultimately the way to halt the decline of wildlife stocks in Africa. Indeed, there needs to be carried out a careful re-appraisal of the effect of certain current laws on the attitudes to wildlife of the affected people. Ways need to be found of restoring the former traditional attitude of many tribal cultures that regards wildlife as a valuable resource over which care and stewardship must be exercised in order that controlled use may continue on a sustained basis. The present survey indicates that in many areas this basic outlook still exists sufficiently to form a foundation from which such a revival could be mounted. At the same time the widespread view, particularly in East Africa, that wildlife is a commodity to be sold to foreigners needs to be changed, so that it becomes a guarded possession which belongs to Africa and is foremost for the benefit and enjoyment of Africa's own people. Ways could then be explored for marketing genuine surplus in a well organized manner, commensurate with biologically feasible off-take rates. More modern approaches such as ranching or domestication could also develop more naturally out of legalized subsistence utilization, allied with a proper sense of stewardship.

2. The Demand for "Bushmeat"

In many West African countries today the demand for wild animal meat is so high that populations of many species are seriously threatened. However, this problem is preferable to one where exploitation is for sheer profit. It is easier to persuade people to conserve a food supply than to get them to forgo a ready source of monetary gain. Nutrition is a much older human preoccupation than economics and the built-in desire for its continuity is much more basic. Thus the dominant need in these areas appears to be to find ways of achieving conservation alongside existing patterns of utilization, which may have to be modified.

West Africa does have an enormous conservation problem and certain aspects of it are being seriously tackled by its own scientists. Solutions being tested to date include the breeding of rodents such as the grass cutter and giant rat in captivity (Asibey, 1969; Ajayi, 1974). More recently, Maxwell's duiker has been proposed for domestication (Whittle, 1977) and at Ibadan experiments are also in progress on bush fowl and guinea fowl. In most Sahelian countries such as Mali and Upper Volta some farmers already domesticate and sell guinea fowl for local consumption (Kundaeli, pers. communication).

In Ghana, in addition to domestication, there has been a proposal to set aside certain areas as "game production reserves" where off-take of wild populations will be carefully controlled.

A promising operation in the controlled harvesting of a wild species is reported from Ife, Nigeria (Halstead, 1977). A regular "bat market" has been set up to sell to local people a big fruit bat which occurs in large numbers in the area. Off-take is carefully monitored and cropping appears to have stimulated reproduction, resulting in an increase in numbers of up to one million in a single colony. Such an exercise, scientifically designed, has great possibilities and could well be repeated with other species, providing the initial population is known to be large enough to tolerate some experimental harvesting. Controlled utilization of wild species is much simpler than domestication and requires very little prior research work or capital investment, making it much easier to modify or abandon the scheme should its continuance prove undesirable for any reason. If, as in the Ife bat scheme, carcasses are sold fresh to local people, no elaborate storage or marketing procedures are necessary, and the exercise has all the advantages of subsistence hunting but with the addition of careful control over numbers harvested.

Areas where the legal framework has allowed a demand for bushmeat to develop and where population density is high, clearly have a conservation problem to which there is no easy answer. The rationalization of increased meat production from favoured wild species by domestication, or controlled harvesting schemes, might go some way toward meeting the demand and ultimately reduce the excessive pressure on wild populations. However, this will take time and in the meantime the range of animals eaten gets wider. Several species, like the manatee and pigmy hippopotamus in Ghana, have already been exterminated (Asibey, 1972), while others, such as some forest primates, are in grave danger. At the same time the habitats harbouring many of these utilized animals are being degraded, further reducing the possibility of preserving the total resource for posterity. It seems likely that interim legislation to protect threatened species and habitats may be the only immediate answer but it should be regarded strictly as a last resort and severely limited usage is far better than an absolute ban. Gradually increased usage should be allowed as soon as it is considered feasible. In no event should any government be content only with the imposition of legislation. Full attention must be given to a long-term solution.

3. The Need for Education

Unless people can be convinced or reminded, on a broad scale, that wild fauna and flora are worth retaining there seems little hope of halting the forces hastening destruction.

The first need is to demonstrate why wildlife is valuable, not only as a food source but for the whole variety of reasons discussed in this paper. Second, the essential interdependence of animals and plants needs to be taught along with the impossibility of retaining useful animals without also preserving their wild habitats. Forests (and savannahs) and the creatures inhabiting them have got to be seen as one integrated resource of irreplaceable value to a country's economic and cultural future. The loss of a species must be seen as an economic and cultural loss; an improverishment which is a disgrace to the present generation.

The concept of replenishment must also be inculcated. Just as a deposit bank account quickly runs dry if the capital is used as well as the interest, so it is with any natural ecosystem or wildlife population. Off-take can only continue as "interest" is generated by the natural rate of reproduction. Presently, demand is frequently far outstripping the replenishment process and wildlife capital is rapidly being used up all over Africa. Once the commodity has come to be valued, some simple accounting needs to be taught to show how a continued supply can be ensured. Very little basic education is necessary for simple investment procedure to be appreciated because dwindling dividends are an unwelcome experience and as such are to be avoided. We should need no greater educational effort to make a dwindling wildlife resource an unwelcome experience, once its full value has come to be appreciated and its fruits more widely enjoyed.

At all levels of education, and perhaps very especially at the primary level, the true facts of Africa's dependence, at least for sometime, on fauna and flora have got to be spelt out. Whilst a great deal of emphasis is currently placed on the western economic approach to nationhood (imports, exports, modern foods, medicine and machines), too little place is given to Africa's economic and cultural uniqueness. How many teachers point out that both rural and urban forms of livelihood in Africa rely extensively on supplementation from a great variety of natural products, obtained from a much wider area than that under actual cultivation? In what textbook can you find accounts of the economic importance and nutritional value of wild vegetables and fruits or meat from game animals, small mammals, birds, reptiles, fish, insects and honey? Or the degree of reliance on the "bush" for fuel, building and craft materials such as leather, bark-cloth and dyes? Who tells Africa's youth of the wealth of its medical knowledge and points out that modern research is increasingly clarifying the physiological action of numerous remedies whose effectiveness has been known for centuries? And to what degree is it being made clear that much present-day habitat destruction constitutes a thoughtless rejection of the ecologically sound views on the balance between man and his environment of many traditional African thought-systems? Indeed, why is the centrality of wild fauna and flora to so much of African culture, philosophy, art and music frequently forgotten or overlooked? Could it be that much education in modern Africa detracts from an appreciation of things African and rather leads young people

to the view that the most important things for today's world come from other continents? Could it be that a restoration of sound attitudes to fauna and flora within Africa will only be brought about when African people begin to insist on the supreme importance of conserving and developing all that is unique to this great continent?

4. Suggested Government Action

It is seriously urged that African governments should attempt to produce answers to these questions within the framework of their total educational strategy. Only when the value of wild fauna and flora has begun to be appreciated among their peoples, will it be possible to introduce measures for conserving and regulating their use which find general acceptance. Wildlife and natural resources agencies should combine with their education ministries to design suitable programmes for dissemination of information at various levels. Books, pamphlets and audio-visual material are needed which lay primary stress on wild animals and plants as an economic and cultural asset. The need to conserve can then become an implicit part of the presentation rather than its starting point.

Actual experience of the recreational value of wilderness areas could also be used much more to help people appreciate this neglected aspect of wildlife's uses. As long as recreational use is largely reserved for foreigners it is bound to produce antipathy in many of the nationals. It is hard for them to appreciate the value of earnings from foreign tourism, much of which goes into central government funds. The promotion of cheap local recreational hunting and animal viewing could contribute towards the total attempt to produce an appreciation of wildlife. In many areas today hunting has the status of a hobby and official recognition and encouragement of it as such could help to create wider interest in conservation. Again, it is a question of taking a long-term view, rather than looking for immediate economic returns.

Another area where some education is urgently needed is among rural and agricultural planners and policy makers. Often these officers fail to appreciate fully the degree of dependence on wild resources, particularly among subsistence agriculturalists and pastoralists. This can lead to serious problems associated with agricultural development, where the aim is to stabilize and increase areas under cultivation, allowing an increased human population. If the increased needs of these people for building materials, fuel, bushmeat and other "wild" products are not taken into account, adjacent areas of wilderness are likely to be too small and rapidly become over-exploited. Trees and bushes are removed in large quantities and soil erosion soon makes the denuded areas unproductive. Degradation to complete desert conditions has resulted in some places. In the worst examples the people have to resort to buying fuel, construction materials and meat and are reduced to the cash economy and indebtedness of the town dweller, thus defeating the original objective of rural settlement.

There is a widespread need across Africa for governments themselves to think through the whole question of the importance and values of wildlife. If more government personnel could be made aware of the current facts, briefly sampled in this paper, the need for a massive re-education process would perhaps become evident. A real change of attitudes at all levels of African society could do more for wildlife conservation than any other single approach. The solution lies within Africa itself and it is in this fact that there is ground for hope. There are numerous examples of problems in Africa having been solved in a comparatively short space of time once the problem and its solution have been perceived from within. It is hoped that this report may make a modest contribution to what is happening with respect to Africa's rich wildlife assets. If only their real importance to Africa's present existence and future aspirations could be perceived, their preservation would be guaranteed.

IV. ACKNOWLEDGEMENTS

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APPENDICES

APPENDIX I

A LIST OF THE USES OF PLANTS IN AFRICA

(From Irvine (1961) "The Woody Plants of Ghana, with special reference to their uses"). Although these uses have been found in the woody plants of Ghana, the list is a good summary of the great variety of plant uses throughout Africa revealed by the present survey.

I FOOD PLANTS
- 1. Roots and Underground Stems
- 2. Stems
  - (a) Bark
  - (b) Sap
  - (c) Stems
  - (d) Pith
  - (e) Gum
  - (f) Young shoots
- 3. Leaves
- 4. Flowers
- 5. Fruits
- 6. Seeds

II CONDIMENTS, SPICES, OR FLAVOURING AGENTS

III BEVERAGES
- 1. Non-alcoholic
  - (a) Water substitutes
  - (b) Water purifier
  - (c) Sweet beverages
  - (d) Milk substitutes
  - (e) Tea substitutes
  - (f) Coffee (*Coffea* spp.) and coffee substitutes
  - (g) Cocoa
- 2. Alcoholic Beverages, with "bitters", stimulants, etc.

IV FODDER PLANTS

V BEE PLANTS

VI SILKWORM PLANTS (including host plants of edible caterpillars)

VII FATS, OILS, AND WAXES

VIII PLANTS WITH MEDICINAL AND VETERINARY USES

IX POISONS AND ANTIDOTES
- 1. Human
- 2. Plants poisonous to domestic animals, game animals, crocodiles, rodents, and snails
- 3. Fish poisons
- 4. Insecticides and Insectifuges
- 5. Vermifuges and Anthelmintics

X SAPONIN-PRODUCING PLANTS

XI TANNIN-PRODUCING PLANTS

XII LATEX-PRODUCING PLANTS (including rubber plants, rubber adulterants and coagulants, and bird-lime)

XIII GUMS, RESINS, AND WAXES

XIV DYES, STAINS, AND INKS - For Mordants, see XVIII, "Vegetable Salts"

XV COSMETICS AND POMADES

XVI PERFUMERY

XVII MUCILAGE PLANTS

XVIII VEGETABLE SALTS

XIX FIBRES
- 1. Basketry
- 2. Barkcloth
- 3. Brushes, brooms, etc.
- 4. Mats, hammocks and fish-nets
- 5. Chewsticks, teeth-cleaners, chewing and cleaning sponges
- 6. Bast fibres, binding material, ropes and cordages, etc.
- 7. Stuffing materials
- 8. Paper pulp, packing paper and wrappings
- 9. Floss for pillows, etc.

XX DECORATIVE PLANTS (including trees, shrubs, and climbers, shade and avenue trees, and hedge plants)

XXI FENCING AND BOUNDARIES
- 1. Living poles and fences
- 2. Fence-poles (palings)
- 3. Boundary trees

XXII HUT POLES, RAFTERS, WALLS, AND YAM POLES

XXIII TIMBER (including heavy construction, carpentry, joinery, windows and doors, plywood and veneers)

XXIV FURNITURE, CABINET-WORK, and TURNERY

XXV DOMESTIC USES
1. Field implements (e.g. in farming and forestry)
2. Hunting implements (bows and arrows, traps, spear-shafts, and gun-stocks)
3. Household implements (bowls, spoons, plates, weaving looms and shuttles and carpenters' tools)
4. Mortars, pestles, mallets, barrels and water pipes
5. Personal (walking sticks, combs, snuff and snuff-boxes, sandals, beads and vegetable ivory (buttons))
6. Boats, tackle and fishing-gear, fishing lines and nets
7. Shingles and thatches
8. Leaves used as wrappers for foods etc.
9. Musical instruments and drums
10. Carved objects, carved stools, images, masks and thorns, etc.
11. Plants used in games
12. Abrasives
13. Pipe-stems
14. Plants used in trapping and as fish-bait
15. Beehives, etc.
16. Pottery
17. Lightning conductors

XVI CHARCOAL

XVII FIREWOOD

XVIII TINDER, TORCHES, AND LIGHTING

XXIX LAND RECLAMATION, SANDBINDERS, AND NURSE-PLANTS

XXX MANURE

XXXI WEEDS

XXXII WEATHER SIGNS

XXXIII PLANTS USED FOR SMOKING FISH, ETC.

XXXIV PLANTS OF BOTANICAL INTEREST (ant-plants, etc.)

XXXV SACRED PLANTS

APPENDIX II

A LIST OF THE USES OF ANIMALS IN AFRICA

This list contains animals uses revealed during the present documentation study.

I ANIMALS USED AS FOOD
1. Mammals - all groups including bats, carnivores, rodents and primates
2. Birds
3. Reptiles
4. Fish
5. Molluscs - snails, lamellibranchs (bivalves)
6. Arthropods - caterpillars and grubs of insects, beetles, locusts, grasshoppers, termites, ants, bees - larvae, eggs, honeycomb, honey, ticks - eaten engorged, crustacea - crayfish, crabs, etc.

II BEVERAGES
1. Blood - supplies salt
2. Antelope rumen contents
3. Mead - honey-based alcoholic drink

III FATS, OILS & WAXES
1. Dura bug oil
2. Beeswax - used as a sealant

IV FUEL
e.g. elephant and hippo fat

V COSMETICS & POMADES
e.g. lion fat

VI PERFUMES
e.g. civet musk

VII DYES & STAINS

VIII MEDICAL AND VETERINARY USES
Numerous medicines of animal origin

IX POISONS & ANTIDOTES
1. Insect larvae, spiders and scorpions - used as arrow poisons
2. Snake venoms - used as arrow poisons

X WEAPONS
1. Bow strings - sinew of large antelopes
2. Arrow binding - small sinews
3. Quiver - skin
4. Arrow fleching - feathers of various birds
5. Arrow heads - bone
6. Shields - buffalo hide

XI CULTURAL USES
1. Musical instruments - drums, bow strings, horns
2. Carved objects - ivory, tortoise shell, horn
3. Components of potions for charms, spells, etc.

XII HOUSE CONSTRUCTION
1. Roof covering - hides and skins
2. Binding - leather thongs, etc.

XVIII CLOTHING
Skins used for footwear, belts, headgear, skirts, etc.

XIV PERSONAL ADORNMENT
Bangles, necklaces, charms made from teeth, ivory, bone, feathers, skin, horn, tail and mane hairs

XV DOMESTIC USES
1. Implements
2. Whip, flywhisks
3. Mats
4. Furniture e.g. stools
5. Vessels - ostrich egg jar, tortoise shell basin, skin bags, etc.
6. Purse - from nest of penduline tit
7. Spoons - snail and other shells

APPENDIX III

An example of a recent list of plants and their uses, (from Nicholas David, 1976). Note the great variety of uses listed - more than 20 - from a list of only 57 plant species. Several species, such as *Adansonia digitata*, the Baobab, are described as having "multiple" use.

Useful plants found in and near settled Fulani villages in the Benue-Kebi confluence area of North Cameroon, a partial listing.

Scientific name	English name	Use
Amaranthus spinosus L.	Spiny amaranth	Pot-herb
Asteroclina species		Pot-herb
Brachiaria ramosa (L.) Stapf		Horse fodder
Cleome hirsuta Sch. & Thonn		Pot-herb
C. ciliata Sch. & Thonn.		Pot-herb
Cyperus cf. *articulatus*		Rhizomes burnt for fragrance
Dactyloctenium aegyptium Beauv.	Comb-fringe grass	Horse fodder
Echinochloa species		Horse fodder
Gynandropris gynandra (L.) Briq.		Pot-herb
Hemarthria altissima (Poir.) Stapf & Hubbard		Thatch
Hyparrhenia species		Thatch
Pennisetum pedicellatum Trin.		Thatch
Polygonum species		Ashes as salt substitute
Trachypogon species		Thatch
Vetiveria nigritana Stapf		Zana matting
Adansonia digitata L.	Baobab	Multiple
Annona senegalensis Pers.	Wild custard apple	Fruit
Acacia albida Del.	Winter thorn	Fodder (dry season)
A. grabica Willd.	Egyptian thorn	Glue
A. polyacantha Willd. subsp. *camplyacantha* (Hochst ex A. Rich.) Brenana	Catechu tree	Fence posts
A. senegal Willd.		Fodder, glue
Balanites aegyptiaca Del.	Desert date	Multiple
Bombax costatum Pellegr. & Vuillet	Red-flowered silk cotton tree	Mattress stuffing
Butyrospermum paradoxym (Gaertn. f.) Hepper subsp. *parkii* (G. Don)	Shea tree	Fruit
Capparis corymbosa Lam.		Arrow poison (root)
Cassia tora L.	Foetid cassia	Pot-herb
Ceiba pentandra Gaertn.	Silk cotton tree	Mattress stuffing
Celtis integrifolia Lam.	Nettle tree	Fruit, pot-herb
Commiphora kerstingii Engl.	African myrrh	Fodder, fence posts
Corchorus olitorius L.	Jew's mallow	Pot-herb
C. tridens L.		Pot-herb
Euphorbia unispina N.E. Br.		Arrow poison (sap)
Ficus gnaphalocarpa A. Rich.		Fruit, fodder
F. iteophylla Miq.		Fruit
F. platyphylla Del.	Gutta-percha tree	Fruit, fodder
F. polita Vahl		Fruit
Gardenia erubescens Stapf & Hutch.		Fence posts
Grewia tenax (Forsk.) Fiori		Wood for bows
G. mollis Juss.		Spice (bark)
Haematostaphis barteri Hook. f.	Blood plum	Fruit
Hyphaene thebacia Mart.	Dum palm	Fruit, matting
Jatropha curcas L.	Physic nut	Hedge plant
Khaya senegalensis A. Juss.	Dry zone mahogany	Canoe wood
Kigelia africana Benth.	Sausage tree	Fence posts
Manihot glaziovii Muell. Arg.	Ceara rubber	Glue, ornamental
Moringa oleifera Lam.	Horse-radish tree	Drink (leaves)
Parkinsonia aculeata L.	Jerusalem thorn	Ornamental
Parkia clappertoniana Keay	Locust bean tree	Flavoring (seeds)
Prosopis africana Taub.		Smiths' charcoal
Ricinus communis L.	Castor plant	Oil
Securinega virosa (Roxb. ex Willd.) Baill.		Withies for beds and traps
Sterculia setigera Del.		String
Tamarindus indica L.	Tamarind	Drink (fruit-pulp)
Vitex doniana Sweet		Fruit, wood for canoes
Ximenia americana L.	Wild olive	Fruit
Zizyphus mauritania Lam.	Jujube tree	Fruit, wood for bows
Z. mucronata Willd.	Buffalo thorn	Fruit

RECOMMENDATIONS

RECOMMENDATIONS ARISING FROM A DOCUMENTATION STUDY OF THE NON-COMMERCIAL UTILIZATION OF WILD PLANTS AND ANIMALS IN AFRICA

PART II

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CONTENTS

I. INTRODUCTION

The recommendation of "specific follow-up action" on the basis of a documentation study is a difficult task. Frequently publications do not give sufficient information on local conditions from which to gauge on-going possibilities and a field assessment is usually needed before proposals can be formed or, indeed, their real desirability determined. Even recent documentation rarely gives a sufficiently up-to-date picture of a situation, either with regard to current utilization practice or the conservation situation. Moreover, a key factor in developing some kind of utilization project is the degree of readiness reflected in local attitudes to the resource and its exploitation. Thus the immediate next-step is often the gathering of more information, possibly from the literature but certainly from an examination of field situations which the present literature search has suggested as probable bases for pilot projects or other specific action. In spite of these constraints a number of observations can be made with regard to follow-up and an attempt will also be made to frame some reasonably specific proposals. In many cases, however, these must be regarded as tentative suggestions that need further feasibility investigation before firm action can be taken.

II. GENERAL

Perhaps the most important observation that needs to be made with regard to conservation action in Africa concerns approach and attitudes. It is obvious that what ultimately counts in this whole field is what sustained action is taken by the people in the situation, viz. the Africans themselves under the leadership of their own politicians, administrators and scientists. As everywhere else in the world, African people will respond to what they understand and are convinced about. This highlights the importance of African insights and perspectives in designing conservation philosophy for Africa. A great deal of current thinking in these matters originates from the northern hemisphere and has its roots in western attitudes and culture. It has to be recognized that such philosophy is often counter-productive when retailed in Africa and other parts of the "Third World". The present study indicates that there is a strong basis for an African conservation philosophy within traditional relationships between people and wildlife on the continent and within African culture. However, it is not always clear to Africans themselves that this is the case and, as pointed out in the main report, there is a need to demonstrate the facts.

Too often in Africa today the best way forward is presented in terms of high technology borrowed from other cultures, particularly that of the scientific west. Implicit in such solutions to Africa's problems one finds a desertion of many of her own traditional approaches to living: even if they are not condemned out of hand, there is an underlying assumption that they are outmoded and not worth considering. Tragically, at the same time, it is not noticed that the proposed technological solution may bring with it various environmental and social evils inimical both to the quality of human life and the long-term interests of the conservation of Africa's unique natural resources. Thus, at both the philosophical and practical level, we must strive to produce a truly African view of conservation which is firmly based on what is best in traditional attitudes to wildlife and at the same time discourages blind faith in imported technology. For this to happen African conservation will have to become a much more productive ideal than its western counterpart whose altruistic and aesthetic foundations find little response in the utilitarian thinking of present-day Africa. Thus African scientists involved in wildlife conservation must be seen to be contributing directly to the real needs of their country and it should not surprise us that most of them see no essential conflict between conservation and utilization.

It is to Africa's own laity, scientists and decision-makers, that we must look for the formulation of an African conservation strategy, with its own ethic and ideals. Every encouragement must be given to young scientists and it is vital that any research or pilot projects on utilization sponsored by IUCN involves them at all levels. Active involvement of local scientists in conservation-oriented projects is one important way to produce the attitudes towards wildlife that are so much needed. Indeed any scientist whose work impinges on some form of wildlife utilization must be urged to include conservation implications as part of his study. It is noticeable that most of the publications consulted during this study do not comment on conservation at all. In many cases a little extra effort would have enabled this to be done quite meaningfully. Another fruitful method in getting attitudes changed has been to approach young people to join wildlife club movements. For example, in Kenya most of the students entering university who have a constructive understanding of wildlife issues are found to have been members of wildlife clubs at secondary school. We must constantly be on the look-out for ways of furthering such movements and making sure that they are fully aware of facts that can contribute towards the development of an African conservation policy.

The publication of existing scientific information relevant to conservation is also an area that would repay attention and possibly financial help. As an example, in the East African Herbarium at Nairobi there is a card-index of some 6,000 cards containing information on African plant uses in Kenya, Tanzania and Uganda. Such data worked up and published with a strong conservation emphasis would constitute an important contribution to the "conserve for utilization" literature. Possibly one ought to insist on a shorter popular version of such a publication in addition to a purely scientific document.

Also in the field of publications, there appears to be a need for the building up of a central library on the utilization of African wildlife. At present there is no single place where one can find even a considerable proportion of the documents listed in the modest bibliography drawn up with this report and it was necessary to visit 18 libraries in four different countries, as well as soliciting certain papers by mail, in order to complete the compilation. The library of the Department of Ethnobotany and Ethnozoology at the Paris Natural History Museum comes nearest to such a collection but, of course, it does not specialize in the uses of African wildlife and contains mainly French papers. Certain kinds of usage are covered in specialized libraries, such as several dealing with plant uses ("economic botany") but there is not a comprehensive collection on all forms of wildlife usage. Careful thought needs to be given to the location of a library of this kind, as its prime aim ought to be assistance to African workers. Certainly Paris would appear to have a strong claim should Europe be deemed the best locality. Within Africa itself, Cameroon should be considered in view of its accessibility to both English and French-speaking parts of the continent and the use of both languages within the country. The establishment of a documentation centre of this kind would go some way toward developing wildlife utilization as a distinct discipline and if other areas of the world than Africa were to be included, a European base would seem to be indicated.

In addition to the need for the furtherance of scientific study and publication, there is a clear necessity to encourage the presentation of information on the importance of wildlife in Africa for the layman. Facts need to be attractively and convincingly presented, with suitable illustrations, in a manner that will arrest the attention of Africa's more thoughtful readers. Regional publications along these lines, by government agencies or commercial publishers, should be encouraged and subsidized financially where appropriate. A valuable lead in the field could be achieved if IUCN were to seek promotion for the writing and publication of a popular book based on some of the material brought to light by the present literature survey. The bibliography and the card-index on which it is based would constitute an invaluable basis for an authoritative but readable account of the facts summarized in the main report. The aim should be to publish versions in both English and French.

III. RESEARCH AND SURVEYS

As pointed out above, in many cases there is a need for clarification and the collection of further information before definite projects in the field of wildlife utilization can be formulated. In particular, the "practices and restraints at present imposed by the current local situation" are rarely clear from the literature and specific field investigation is called for to clarify such matters. This section will draw attention to a number of investigations that have relevance to the interest in furthering utilization as a basis of African conservation practice. In most cases the need is not for expensive long-term research of a fundamental nature but rather a relatively rapid assessment of a specific area of information or practice. It would be carried out with the specific aim of defining the feasibility of setting up a practical development operation (pilot project).

1. Economic Studies

In order to assess certain existing usage practices as possible bases for the development of simple commercial operations it is important that they receive careful appraisal by a sensitive economist. Currently, good data on such matters as collection and marketing costs, prices and demand is very scarce or at best incomplete. Well designed field surveys of no more than a few months duration could provide the requisite information. The usage practices concerned are those where a wildlife product is collected in excess of the gatherer's own needs and sold or exchanged.

The minor bushmeat trade in a number of West African countries such as Liberia, Ghana and Nigeria provides an example. Some relevant data has already been collected by Asibey in Ghana and Ajayi in Nigeria and could form the starting point for more systematic economic surveys in those countries. Similarly, the economic data of von Richter on local hunting for meat and skins in Botswana could provide a basis for studies in that area. Zaire is another country where local trade in game products, especially meat, would reward careful economic appraisal.

The considerable trade in honey and beeswax collected from wild bees is a further form of utilization which appears to have wide potential for development in a number of areas. The African bee was imported into Brazil in 1956 and since then the production of honey and beeswax there has increased by 36%, and yet the rationalization of honey production in many areas in Africa itself has never been attempted. In Kenya the Wakamba, Embu, Meru and Wandorobo tribes provide examples of basic economies where beeswax and honey are important and would repay economic appraisal. The Bee Research Association of U.K. has some relevant information on "beekeeping" in Africa and should be consulted prior to any study of its economics.

It seems feasible that one economist, with some knowledge of African subsistence economics, could be employed on a consultant basis to undertake a series of economic studies of the kind proposed. His brief should be clearly slanted towards the defining of development possibilities arising out of existing economic structures. Drs Asibey, Ajayi, Marks and von Richter should be consulted in drawing up such an economic survey. It is possible that FAO would be interested in cooperating in a project of this kind as they have for a long time had an interest in promoting the utilization of wildlife in Africa, particularly as a protein source. Two FAO officers wrote, in relation to Africa, that "Economic surveys of wildlife are urgently needed to establish a comprehensive picture of the resource" (de Vos and Kaittany, 1972).

2. Ecological Impact of the Bushmeat Trade

It is clear from a number of publications that the bushmeat that is characteristic of such West African countries as Liberia, Ghana, Togo, Benin and Nigeria has had a serious effect on the numbers of many species involved and in most cases constitutes at least local over-exploitation of the resource. It is an example of uncontrolled utilization, in which the enormous increase in demand by a growing human population has far outstripped the reproductive capacity of the animals involved. Cries from conservationists to stop the trade and give full protection to the animals have largely gone unheeded and it is clear other solutions must be sought. As already noted, men such as Asibey and Ajayi are actively pursuing one part of a solution, viz. increased production of favoured species by rearing them in captivity. In line with their efforts, any other solutions proposed must aim to increase productivity as quickly as possible. Solutions that propose closing down the trade completely for the time being arouse suspicion of an attempt to stop utilization and merely preserve populations as curiosities in perpetuity. An acceptable solution must have economic justification.

It is impossible to devise good plans for the rationalization of the bushmeat trade without an indication of the true ecological situation with regard to the habitats and population numbers of the species involved. A study of these factors is needed in parallel with the proposed examination of the economic aspects of the trade. Such an ecological study would be partly a collation of existing data and partly the collection of new field information. A considerable amount of data exists on consumption rates and this could be updated and expanded in collaboration with existing local scientists and the economist. There is very little precise information, however, on the state of wild populations of such species as duikers, bushbuck, small carnivores and the larger rodents (it is proposed that primates are investigated independently). There is general agreement that in many cases numbers are perilously low but how low is not stated. In spite of the difficulties in censusing medium and small sized forest mammals, it is imperative that some sort of objective base-line for heavily utilized species be obtained. Recent progress in techniques is very promising: Sinange in Kenya has found ways of estimating numbers of small suni antelope

in thick coastal forest and Kundaeli has devised other methods for the tree hyrax in Kilimanjaro forest in Tanzania. A quick sampling method that can be applied in a variety of West African forest ecotypes would enable at least a relative picture of status and numbers to be obtained in some of the areas most heavily exploited for bushmeat. Similarly, some measure of rate of habitat destruction needs to be applied so that trends can be determined and future availibility of habitats for bushmeat production predicted.

Recommendations based on objective data on numbers and habitat might include, (i) the setting of a quota system for off-take by local hunters in prescribed areas, (ii) a simple licensing system which effectively limits the number of hunters in a given administrative region, (iii) a straightforward formula to enable local administrators and wildlife officials to relate off-take quotas and hunter numbers to current numbers of the hunted species available. In many instances the total off-take permitted initially would probably represent a reduction over recent uncontrolled rates. With fast breeding small species such as some rodents, however, it is likely that a progressive increase in rates would soon be feasible as numbers built up in response to the curbing of over-exploitation. A licensing system countrywide should enable a better distribution of hunting effort over the entire resource area, avoiding excessive hunting near to areas of high demand such as large towns.

Whilst there is obviously no rapid answer to the present over-exploitation of forest and bush animals for meat, a structured framework for the trade would be a move in the right direction. Even a framework embracing present levels of off-take would be an advance on the understructured and unaccountable system widely pertaining at present. Once a simple framework of control is accepted it can be used to work towards a proper balance between exploitation and replenishment. At all costs, the introduction of control must be seen from the outset to be in the interest of the hunter and presented as an improvement and eventual expansion of the *status quo*, rather than the clamp-down of officialdom on an enjoyable and profitable way of livelihood. Emphasis throughout should be on functional simplicity and not legislation for its own sake.

3. A Primate Utilization Study

In many areas of Africa the utilization of primates has now reached excessive proportions. This includes both widespread domestic consumption as meat and the capture and export of live animals for research purposes. The recent refusal of the Indian Government to allow the continued export of primates to the USA for research is likely to create an increased demand for African primates in that country. It is recognized that research utilization does not fall within the terms of reference of this report. However, it seems possible that the concern being generated over the question of the commercial supply of laboratory primates and proposed investigations aimed at the rationalization of that trade may provide an opportunity to collect data on primate populations as a whole, including many of those being harvested for bushmeat.

According to Asibey, the utilization rate of monkeys in West Africa is high and several species are in danger of extermination or have already disappeared except in reserves, as in the Ivory Coast. Even chimpanzees form a regular item of diet where they are available. Jeffrey's (1977) recent report on Liberia indicates that the meat of monkeys is next most common to that of antelopes and that considerable numbers of chimpanzees are also being exported. So there may be an argument for an overall assessment of primate populations and status as a special case, in view of dual pressure on their numbers from commercial and domestic usage. As primates are slow breeders it is likely that some species are in urgent need of special protection if extermination is to be avoided. Primates in the bushmeat trade may have to be dealt with in a separate category from other animals in view of their special biological characteristices such as slow reproduction and growth rates.

Consultation with the National Institutes of Health and the Inter-agency Primate Steering Committee of the USA is recommended if the suggestion of a special primate study, including the supply of laboratory animals, is followed up. If it is decided not to consider primate exploitation as an independent case, then clearly it should be included in both the economic and ecological studies of the bushmeat trade recommended above. In any event, it is imperative that attention to primate conservation receives high priority and the most rapid way of obtaining objective data on their numbers, particularly in West Africa, should be pursued with vigour. Dr T. Struhsaker of the Smithsonian Institution, Washington, D.C., and Dr J.S. Gartlan of the Field Research Centre, B.P. 34 Edea, Sanaga Maritime, Rep. de Cameroun, should be consulted over the setting up of a primate survey and appropriate methodology.

4. Domestic Uses of Fish

Many of the FAO surveys on consumer habits involving fish include subsistence and auto-consumption patterns. This information is not reflected in commercial data and is not available in the more obvious fisheries literature. It is suggested that available data be collated and synthesized with a view to applying the findings, if not already done, and to identify gaps in knowledge for further investigations.

5. Baobab Numbers and Status

The baobab is very widely used for a variety of purposes (Adam, 1962, lists sixty) and although many of these do not involve destruction of the tree, questions as to the conservation status, numbers and distribution of the species are clearly of importance. This is particularly so since in some areas, such as Tsavo National Park in Kenya, great numbers have been destroyed by elephants in recent years and regeneration has not been keeping pace with the disappearance rate. Baobab is a slow-growing, long-lived species of tree with proven utilization potential and is probably in need of special conservation measures in some areas.

An Africa-wide survey of baobab numbers and population age structure, as well as forms of utilization, would reveal the true situation of this tree. At the same time data on major usage patterns would indicate whether there are possibilities for developing commercial activities based on this typically African plant. Dr J.G. Adam should be consulted in devising a project on the baobab as well as the Threatened Plant Group at Royal Botanic Gardens, Kew, U.K., under the leadership of Mr G. Lucas, who himself has specialized knowledge of the baobab group.

6. Uses of Wild Plants in Construction and Crafts

There is much evidence of the widespread uses of treés, shrubs and grasses in the construction of houses, furniture, tools, utensils, and boats, and in crafts such as raffia work

and barkcloth. However, very little exact information on the species and amounts used is available in literature. A thorough study of this important area of plant utilization, including some analysis of the characteristics which make a plant or group of plants suitable for a particular usage as well as economic aspects, would greatly help to emphasize the value of wild plants, especially trees, in resource development planning. This would also enable areas for potential growth and development to be identified; there must be many of these, especially where crafts are concerned.

Considering the high cost of most modern and imported building materials such as cement, asbestos and steel, it is appropriate that the usefulness of many local materials be pointed out and there is evidence from some countries, such as Tanzania, that officials are beginning to realize this already, expecially in relation to rural housing schemes. Schemes for the carefully controlled utilization of scientifically selected local materials, with appropriate mechanical strength and insect- and fungus- proof properties, could make a positive contribution to long-term plant conservation. An African scientist with training in architecture or civil engineering and an enthusiasm for "appropriate technology" would be a suitable candidate to undertake a survey of this kind. The Department of Architecture at the University of Nairobi has an African Housing Unit but to date they have concentrated on the form rather than the materials of traditional buildings. It may be possible to carry out a survey of the type proposed in conjunction with the Unit. An alternative might be the Intermediate Technology Development Group in London (Parnell House, 25 Wilton Road, London SWIV 1JS).

7. Wild Plants as Food and Possible New Domesticants

Another important area of plant utilization which is also in need of delineation and assessment is that of the uses of wild plants as food, including their crucial importance as famine food. To a large extent this survey would involve the collation and arrangement of information scattered throughout recent literature. A number of lists of plant species and their uses as foods and beverages have been published in the last 15 years but no comprehensive account of the subject exists, showing, for example, which are the most used plant families in various geographical regions or indicating where there may be possibilities for new domestications. Indeed, whilst there is considerable historical discussion as to the "how" and "where" of previous domestications there seems little concern as to current candidates for cultivation as food plants. It is a fact, however, that a number of species are described as being "semi-domesticated" in some areas and these would clearly need to receive initial attention in any attempt to identify new domesticants.

A survey of this kind would probably best be carried out by a university or museum botany department with an established interest in African economic botany. One such institution is the Department of Ethnobotany in Paris where much of the work on former plant domestication in Africa took place under the direction of the late Professor R. Porteres. However, there may be nutritional or agricultural research institutions within Africa with sufficient breadth of interest to accommodate such a study. Access to relevant literature, including that of anthropology and human ecology, would be an important prerequisite. With their great involvement in finding new sources of food, it is possible that FAO might be persuaded to finance this project or indeed, to provide personnel and facilities for its execution.

8. Studies on Cultural and Social Importance of Wildlife

As indicated in the main report, there is considerable published information on the cultural and social influences of wild animals and plants, particularly in anthropological literature and the proceedings of two recent symposia in Paris published under the auspices of the Institut International d'Ethnosciences. However, many of the more traditional anthropologists have tended to confine their attention to small ethnic groups least influenced by modern technology. There are thus some gaps in knowledge concerning those groups which have undergone some cultural changes resulting from the impact of modern technology. Often, these groups constitute a major portion of the population in some countries and are likely to influence the course of development in such countries. It is therefore important that recommendations to governments should take this into account since the overall aim should be to produce a comprehensive and balanced picture of the importance of wildlife in the cultural and social life of modern Africa. It is recommended that studies be commissioned which give a more detailed analysis of existing information than has been possible in the present study and that more attention be given to securing information on those groups which have departed somewhat from their earlier traditional patterns.

The nature of this study is such that it would be desirable to have African scientists involved in its execution. The Institute of African Studies at the universities of Ibadan and Nairobi might suitably be involved in work in English-speaking countries of West and East Africa respectively, with perhaps the Institut Fondamental d'Afrique Noire in Senegal paying attention to francophone areas.

The Departments of Ethnobotany and Ethnozoology in Paris under the direction of M. Raymond Pujol have played a leading role in work of this kind in recent times and should be consulted in the design of the survey, as well as possibly exercising a coordinating function for the work itself. Dr David Brokensha and his colleague Dr Bernard Riley of the Social Research Institute at the University of California, Santa Barbara are also suitable consultants, having recently completed a penetrating analysis of the part played by plants in a branch of the Kikuyu tribe in Kenya.

IV. PILOT PROJECTS

Several forms of wildlife utilization have come to light during the documentation study where there appears to be a basis for actual experimental development. In two cases there has already been some field and laboratory research on the products, the results of which reinforce the possibilities suggested by investigation of the traditional usage practices. Brief summaries of the research findings to date are presented in appendices to this part. Sufficient information is not available to the author to enable him to formulate full project outlines but this could be done within a short time by appropriate IUCN staff, were it decided to take action on any of the following recommendations. Similarly, precise location of pilot projects would need to be considered in conjunction with government and other appropriate officials in the African states concerned.

1. *Acacia albida* Forage Project

Appendix I summarizes research findings (to 1975) on the possibility of using *Acacia albida* Del. as a source of forage, particularly in the more arid regions of Africa to which this leguminous tree is native. It clearly has quite outstanding qualities in the high protein content of its pods and leaves; the fact that these are produced in the dry season and maintain their quality on storage is significant. In addition to its forage value for all types of domestic stock, *A. albida* is used by people as a famine food in various parts of Africa and also yields a good quality gum.

It is recommended that a pilot project be established to provide field testing of the protracted use of *A. albida* as forage for camels, cattle, goats and sheep. The storage, transport and marketability of the pods should also be put on trial, preferably in areas where there is frequent drought and shortage of conventional fodder. Its value as a human food and producer of gum should be tested simultaneously, including trial packaging, marketing and preparation of seeds as food.

Suitable areas for such a project would be the Sudan (where earlier investigations by agriculturalists have been carried out) or Northern Nigeria or Niger. Ideally, a site is needed where the trees are growing naturally in reasonable numbers and are already used as fodder to some extent by local pastoralists. The effect of continuous harvesting of leaves (both by direct browzing and by cutting) and pods on trees of different ages can be evaluated, as well as trying out various culturing and propagation approaches with young trees. An important aspect would be to test the acceptability of the products to a variety of pastoralists both within the vicinity of the project and further afield, especially in the arid areas where the tree does not occur naturally. An agriculturalist with experience of arid zone pastoralism would be a suitable person to direct a project of this kind.

2. The Use of Blue-green Algae as Human Food

Appendix II summarizes research findings (to 1975) on the possibility of using blue-green algae, of the genus *Spirulina*, as human food. The species *S. plantensis* has been gathered and eaten for many generations around Lake Chad and contains 60-70% good quality protein, as well as being rich in vitamins. A pilot project is already in operation in Mexico, collecting and processing a Mexican species of *Spirulina* for sale as chicken feed. Following this central American model it would be a comparatively straightforward exercise to set up a project on the shores of Lake Chad to test the feasibility of marketing the dried and processed algae.

Initially a high-protein animal food could be tested, later progressing to using the product as a human food additive. A good deal would clearly depend on ability to produce a palatable product which could find sufficiently wide acceptance among people. Areas of acute protein shortage during times of famine, such as the Sahel, might prove a suitable target for initial trials of human acceptability. An expert in food processing in Africa would be needed to direct such a project, with assistance in the marketing field. Funds from a body such as FAO might be available for a pilot project of this kind. The fact that considerable background research on this form of nutrition has already been conducted makes this project worthy of serious consideration.

3. The Expansion of Subsistence Hunting into a Minor Industry

A more or less distinct area of animal utilization practice is the type of subsistence hunting analysed by Marks (1976) for the Valley Bisa of Zambia. Information on such hunting is very difficult to obtain because much of it is illegal and yet it represents a potentially important minor industry. I am grateful to R.H.V. Bell for pointing out that whilst commercially organized game cropping schemes are often expensive failures, "poaching" is evidently a highly successful enterprise. Reasons for this success appear to include:

(i) Low labour, equipment and transport costs
(ii) Absence of unrealistic hygiene requirements
(iii) The result is a cheap, familiar product that finds a ready market
(iv) Low investment means low commitment: if hunting is stopped for a while there is no capital standing idle and there are no maintenance costs.

An experimental field project on "above-subsistence" hunting, within a legal framework, of the type practised in relation to large game in some East and Central African countries, could highlight a number of important forms of wildlife utilization. Such a project could be carried out at a small fraction of the cost of several of the large commercial utilization experiments that appear to have been economic failures.

Clearly a crucial aspect would be to find a country with a suitable legal framework for a project of this kind, i.e. where local people can obtain licences for individual or group hunting and where products such as game meat and hides can be marketed readily. Possibly Botswana, Ghana and/or Tanzania would provide appropriate settings. The project would be designed to test the feasibility of a rural community, living in an area of large or medium sized game, providing their own animal protein requirements and also a cash income for other needs from sustained hunting. Points of particular importance would include the density and type of game available, habitat, seasons and hunting techniques (modern rifles, muzzle loaders, bows and arrows, netting etc.); hygiene, transport and marketing of surplus. The project should retain as much of traditional methodology and approach as possible, particularly as regards social factors such as the composition of hunting parties and division of products (meat and cash from sales), and local restraints on over-hunting. An overall point of emphasis would be to keep capital investment as low as possible while maintaining legality and profitability. It would further be necessary to demonstrate how this kind of small-scale exploitation can be sustained without throwing extra strain on game departments or law enforcement officials and without depleting game stocks. From the economic point of view it may be desirable to await the findings of the proposed economic studies (see Research and Surveys, 1) before designing a pilot project of this kind.

A practical wildlife field officer (Mweka or Garoua trained) would probably be the best type of person to organize a project such as this. Ideally it should be carried out within the programme of a game or wildlife department or certainly in full collaboration with one. The experience of Dr Marks in Zambia would be useful in designing the project and Dr von Richter, ex-Botswana, would also be able to contribute valuable advice. One realizes that there would be many difficulties and dangers in embarking on a project of this kind and opponents would be plentiful. At the same time it has to be recognized that at present many rural communities only survive by obtaining meat by illegal hunting. If a way can be found to put this form of animal utilization onto a legal footing and at the same time provide a modest cash income to the rural communities concerned, it will be much better for the long-term survival of the species in question.

V. CONCLUSIONS

As concluded in the main report, one key to conserving Africa's wildlife lies in producing a convincing demonstration of its usefulness to man in the variety of ways mentioned in this study. On such conviction must be based the gradual production of new attitudes and values in people at large. The recommendations presented here must be seen in this same light. None of them is of much merit when viewed in isolation. When considered in their totality, however, and against an overall atmosphere of improving appreciation of the value of wildlife, it is hoped that they will make good sense and constitute a valid contribution to the ultimate conservation aim.

APPENDIX I

A BRIEF SUMMARY OF EXISTING INFORMATION AND SOURCES ON THE POTENTIAL OF ACACIA ALBIDA AS A FORAGE CROP (FROM ANON. 1975. UNDEREXPLOITED TROPICAL PLANTS WITH PROMISING ECONOMIC VALUE)

Acacia albida is a leguminous tree, widespread in tropical and southern Africa (extending to Cyprus, Israel and Lebanon), which, curiously, bears its leaves through the dry season and sheds them at the start of the wet season. The reason for the tree's peculiar behaviour - in full leaf when most other plants are leafless - is not fully understood. *Acacia albida* has great promise as a forage plant in areas with a prolonged dry season.

Its foliage is a valuable fodder for all types of stock. The young leaves and shoots are usually avidly browsed. Livestock that eat *Acacia albida* remain in good condition during the dry season when it is often the only green growth available. The tree is often lopped and branches carried to the camels, cattle, sheep and goats. The pods, too, are eaten by livestock, especially cattle, and also by elephants, antelope, and baboons. The nutritional value does not deteriorate on drying (which is the case with many other acacias), so *Acacia albida* is fed dry in many parts of Africa. In the Sudan, trees produce an average of 135 kg of pods per tree. The yield from a stand of 12 trees in the Sudan has been calculated to be 200 kg of crude protein from the pods alone. This compares favourably with 180 kg of crude protein from a crop of unshelled groundnuts. The two crops can, and are, grown together, since the groundnuts (and other crops) are grown during the wet season when the *Acacia albida* is leafless.

Acacia albida is a large, thorny tree. It is sometimes shrubby, but grows up to 25 m high if allowed to grow uncoppiced. In West Africa, it is generally left standing in the arable lands. Leaf-litter decay and excreta from grazing animals during the dry season enrich the soil, which has resulted in greatly increased yields. There is, as yet, no evidence of any appreciable benefit from nitrogen fixation by the roots.

The seeds contain up to 27% crude protein and are eaten by people in Rhodesia during times of famine. The seeds are boiled to loosen the skin and then reboiled to separate the kernels. A mature tree can produce more than a million seeds a year.

Acacia albida pods may be mixed with maize and groundnut meal for food or combined with hay and succulents for fodder.

In southern and eastern Africa, *Acacia albida* is always found in riparian communities, but in West Africa it also grows away from river banks and water courses - often in cultivated lands. Its growth patterns vary widely; sometimes the trees grow singly, sometimes in groups whose upper branches grow together forming a canopy. Although it can be found at altitudes up to 1,800 m in Uganda, and as high as 2,300-2,500 m in the Sudan, it is more usually found below 1,200 m. In areas where the soil is permanently moist, the tree is likely to remain green for longer periods than in those areas where the soils are only seasonally moist. Where there is a bi-modal rainfall pattern, there are two flowering periods and two flushes of leaf per year.

The sapwood is dirty white. The soft, yellowish-white heartwood is subject to attack by borers and termites. Although it is easy to work, it springs and twists after sawing, even when the wood is seasoned. The old bark is rich in tannin (28%), the roots and pods are not (5%). In northern Nigeria, the pounded bark makes a packing material for pack saddles for oxen and donkeys. In West Africa and Tanzania the tree yields a gum of good quality.

LIMITATIONS AND SPECIAL REQUIREMENTS

Acacia albida trees are thorny. Some pods are reputed to taint milk when fed to dairy cows.

The seeds, as in many other species of *Acacia*, are sometimes heavily infested with bruchid beetles. The seedlings are especially susceptible to insect damage, but no more so than many other native species.

RESEARCH NEEDS

Acacia albida deserves further investigation throughout its natural habitat to determine ecological demands and limits such as soil, climate and altitude. Experimental plantings in arid regions of Central and South America, Asia, and Australia should be conducted to determine:

The amount of forage produced and its nutrient value;
the effect on livestock of protracted feeding;
the techniques for propagating and cultivating the plant;
its potential for coppicing (regeneration via new shoots);
the effect of browsing on the plant;
the effect of the thorns on animals (camels don't seem to care);
the effect of nitrogen fixation; and
its potential to fix nitrogen.

SELECTED READING

Codd, I.F.W. 1951. Trees and shrubs of the Kruger National Park. Botanical Survey Memoirs, 26. Department of Agriculture, Cape Town, Union of South Africa.

Dalziel, J.M. 1937. Useful Plants of West Tropical Africa. Crown Agents for the Colonies, London, p. 202.

Hunting Technical Services (G.E. Wickens). 1968. Land and Water Resources Survey of the Jebel Marra Area, Republic of the Sudan. Reconnaissance Vegetation Survey. *Acacia albida* Del. - a general survey (with special reference to observations made in the U.N.S.F. Jebel Marra Project) Volume 2, Appendix IV, pp. 24-72. Food & Agriculture Organization of the United Nations, Rome (Order number: LA:SF/SUD/17).

Irvine, F.R. 1961, Woody Plants of Ghana. Oxford University Press, London.

Radwanski, S.A., and G.E. Wickens. 1967. The ecology of *Acacia albida* on mantle soils in Zalingei, Jebel Marra, Sudan. Journal of Applied Ecology, 4:569-79.

Watt, J.M., and M.G. Breyer-Brandwijk. 1962. Medicinal and Poisonous Plants of Southern and Eastern Africa. 2nd Ed. E. & S. Livingstone Ltd., Edinburgh.

Wickens, G.E. 1969. A study of *Acacia albida* Del. (Mimosoideae). Kew Bulletin. 23:181-202.

APPENDIX II

A BRIEF SUMMARY OF INFORMATION AND SOURCES ON THE POSSIBILITY OF USING BLUE-GREEN ALGAE (SPIRULINA SPP.) AS A SOURCE OF HUMAN FOOD (FROM ANON. 1975. UNDEREXPLOITED TROPICAL PLANTS WITH PROMISING ECONOMIC VALUE)

*Spirulina** species are blue-green algae often found in saline - usually alkaline - water. For many generations one species has been eaten in the Lake Chad area of Africa. In the 16th century the Spanish Conquistadores found the Aztecs using spirulina as their main source of protein. Some 60-70% of spirulina is good quality protein. It is also rich in vitamins and no harmful components have been found.

At Texcoco, near Mexico City, a new pilot plant has been set up to collect and process spirulina. About one ton of dry spirulina is produced daily; it is sold as high-protein, high-carotene additive for chicken feed.

Extensive research has been conducted into the possibility of using spirulina as food for humans.

The ability of this algae to thrive in highly saline and alkaline water is a great advantage. It grows well in waters containing up to 14,000 mg/litre of chloride, and of alkalinity up to pH 11. However, divalent ions, e.g. magnesium ions, must be properly balanced or eliminated. Seawater, for example, is not suitable because of its magnesium content. Carbon dioxide reacts chemically with the often alkaline culture medium, resulting in a high degree of carbon dioxide utilization. This makes growing of spirulina an efficient, productive process. Under favourable conditions production rates averaging 12g/m^2/day or more are possible.

Spirulina production involves culturing the algae in basins and then harvesting, washing, drying and storing the product. Spirulina is large enough to be recovered from the culture medium by simple filtration. In Chad, villagers recover it by using muslin. This is spirulina's great advantage over other micro-organisms that are often promoted as new protein sources, but are difficult and expensive to recover. Spray drying gives satisfactory results. Dried spirulina is not susceptible to fermentation and is easily stored. Solvents will bleach the green coloration to a pale, fawn colour with almost no loss in nutritive value.

Spirulina can be added (up to 10% by volume) to cereals and other food products without changing the flavour or creating objectionable tastes. Spirulina's crude protein can reach as high as 72% (of dry matter) with a satisfactory balance of essential amino acids, except for a slight deficiency in the sulphur amino acids. It has a high vitamin content, particularly vitamin B_{12}. In rats the product was shown to have a digestibility of 84%, with a net protein utilization of 61 and a protein efficiency ratio of 2.3 (casein was 2.5). The nucleic acid content on a dry basis was 4.1%*. The tests

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* *Spirulina platensis* (Chad species) (also known as *Arthrospira platensis*) and *Spirulina maxima* (Mexican species). Family: Cyanophyceae.

For discussion of the importance to arid lands of vegetation that grows with saline water see More Water for Arid Lands.

showed no acute toxicity. Subchronic toxicity studies showed that dried algae (up to 10%) in the diet did not have any deleterious effects on the rats.

The cost of spirulina is heavily influenced by the production rate per unit area (which can be very high), the scale of manufacture, the life of the (polythylene) covering over the production basins, the cost of decolorization, and the cost of land.

LIMITATIONS AND SPECIAL REQUIREMENTS

Growing spirulina culture in artificial media requires a level of technical sophistication difficult to obtain in many developing nations.

Spirulina grows optimally at temperatures from 30°-35° in arid or semi-arid regions where there is little temperature variation.

Climates most favoured for spirulina production are between latitudes 35° north and 35° south. Within this zone, the best locations are those with much sunlight, moderate rainfall, water of reasonable quality, and where there is a carbon dioxide source (such as natural gas or other hydrocarbons). Land should be inexpensive and reasonably flat.

If spirulina production is not carefully managed, bacteria or viruses can contaminate the product.

Data available at present are insufficient to predict the economics of spirulina production; more extensive feasibility studies are needed to justify investments.

RESEARCH NEEDS

Further research and development is needed on mass cultivation of spirulina in artificial basins. Inexpensive watertight basins would greatly reduce investment costs. Improved CO_2 supplies and culture medium stirrers would also lower costs.

The highly promising laboratory results on mineral nutrition, salinity, carbon dioxide requirement, radiation, etc., need to be confirmed in field tests under actual operating conditions.

Harvesting and processing the algae are still relatively expensive and therefore require more research and development.

If mutants tolerant of magnesium ions can be found, spirulina could be grown in seawater. This would increase its utility and make it possible for it to grow in many regions. Mutants with the ability to fix nitrogen would also be desirable.

Spirulina has been eaten for generations in Chad and Mexico. But before it can be considered absolutely safe for humans on a long-term basis, multigeneration feeding studies with animals and prolonged feeding tests with humans are required.

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* This is a low nucleic acid: protein ratio compared to bacteria. For this reason spirulina can be eaten directly by humans without removal of the nucleic acids. Bacterial sources of protein cannot.

Social mores and eating habits have to be overcome before spirulina can become an acceptable human food additive.

SELECTED READING

Clement, G. 1970. An algae of high protein content. Science, Progrès, Découverte. 3423:39-46.

Clement, G. 1971. Une nouvelle algue alimentaire - la spiruline. Revue de l'Institut Pasteur de Lyon. 4(2): 103-14.

Clement, G. and H. van Landeghem. 1970. *Spirulina*: ein günstiges Objekt für die Massenkultur von Mikroalgen. Berichte der Deutschen Botanischen Gesellschaft. 83 (11):559-65.

Hudson, B.J.F., and I.G. Karis. 1974. The lipids of the alga *Spirulina*. Journal of the Science of Food and Agriculture. 25:759-63.

Hiroshi, N. 1970. The Mass Production of Spirulina - A Helical Blue- Green Algae as a New Food. Microalgae International Union, Airlie Gardens, London.

Ogawa, T., and G. Terui. 1970. Studies on growth of *Spirulina platensis*. On the pure culture of *Spirulina platensis*. Journal of Fermentation Technology. 48 (6):361-7.

Soeder, C.J. and W. Pabst. 1970. Aspects for the use of microalgae in feeding humans and animals. Berichte der Deutschen Botanischen Gesellschaft. 83 (11):607-25.

The Protein Advisory Group of the United Nations. 1973. Protein from microalgae and microfungi. Tropical Science. 15:77-81.

RESEARCH CONTACTS AND GERM PLASM SUPPLY

Abteilung für Algen forschung der Gesellschaft für Strahlen- und Umwelt- forschung, Bunsen-Kirschhoff-Strasse 13, D-46 Dortmund, Federal Republic of Germany (C.J. Soeder and H.D. Payer).

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CONTENTS

BIBLIOGRAPHY ON NON-COMMERCIAL USES OF WILD SPECIES OF FAUNA AND FLORA IN AFRICA

BIBLIOGRAPHY

I. GENERAL

Bibliographie ethnographique de l'Afrique sud-saharienne, 1962 (1964). Musée Royal de l'Afrique Centrale Ter., Belgium.

Bibliothèques et Centres de Documentation (1974) Bulletin d'information et de Liaison VI (4). Ecole pratique des hautes études CARDAN, Paris.

DUBOIS, D. (1975) Quelques éléments pour une recherche bibliographique en ethnozoologie. In: l'Homme et l'Animal. Premier colloque d'Ethnozoologie. Inst. Int. d'Ethnosciences. Paris.

LINEAR, M. (1973) The Conservation of Nature through the natural exploitation of wildlife resources. Munchen, Weltforum IFO Inst. 105 pp.

MURDOCK, G.P. (1959) Africa Its Peoples and their Culture History. McGraw-Hill, New York.

TURNBULL, C. (1976) Man in Africa. David & Charles, London, 313 pp.

II. PLANTS AND ANIMALS

1. Various Uses of Plants and Animals

ANON. (1976) Premier Colloque d'Ethnosciences. Paris, 23 au 26 novembre, 1976. Résumés des communications. Institut International d'Ethnosciences, Paris.

CLOUDSLEY-THOMPSON, J.L. (1977) Man and the Biology of Arid Zones. Edward Arnold, London.

GESSAIN, M. & KINZLER, T. (1975) Miel et insectes à miel chez les Bassari et d'autres populations du Sénégal Oriental. In l'Homme et l'Animal. Premier colloque d'Ethnozoologie. Inst. Int. d'Ethnosciences, Paris.

KAY, G. (1964) Chief Kalaba's Village: a preliminary survey of economic life in an Ushi village, Northern Rhodesia. Rhodes-Livingstone Papers No. 35. Manchester University Press.

MONOD, Th. (Ed.) (1975) Pastoralism in Tropical Africa. O.U.P., London.

REED, W., BURCHARD, J., HOPSON, A.J., JENNESS, J. & YARO, I. Fish and Fisheries of Northern Nigeria.

REYNOLDS, B. (1966) The Material Culture of the peoples of the Gwembe Valley. Kariba Studies III. Manchester University Press, Manchester.

SCUDDER, T. (1962) The Ecology of the Gwembe Tonga. Manchester University Press, Manchester.

SHAW, E.M. & Van WARMELO, N.J. (1974) The Material Culture of the Cape Nguni. Part 2 Technology. Ann.S. Afr. Mus. 58 (2), 103-214.

SHAW, E.M., WOOLLEY, P.L. & RAE, F.A. (1963) Bushman Arrow Poisons. Cimbebasia 7, 1 - 41.

TESSMANN, G. (1913) Die Pangwe. Völkerkundliche Monographie eines west- afrikanischen Negerstaummes. Ernst Wasmuth A.G. Berlin, 402 pp.

TROWELL, M. & WACHSMANN, K.P. (1953) Tribal crafts of Uganda O.U.P., London.

TURNBULL, C.M. (1965) The Mbuti Pygmies: an ethnographic survey. Anthrop. papers of Amer. Mus. Nat. Hist. N.Y. Vol. 50 (3).

WOODBURN, J. (1970) Hunters and gatherers. The material culture of the nomadic Hadza. London. Trustees of the British Museum, 59 pp.

2. Use of Plants and Animals as Food

ADRIAENS, E.L. (1951) Recherches sur l'alimentation des populations du Kwango. Bull. Agr. Congo Belge, XLII (3), 473-552.

ANON (1961) Alimentation des populations rurales du Delta rif du Niger et de l'Office du Niger. Mission socio-économique du Soudan, République du Mali.

ANON (1968) Food composition table for use in Africa. F.A.O., 306 pp.

ANON (1968) Liste des aliments consommés du Maroc. Ministre de l'Agriculture et de la Réforme agraire.

ANON (1974) A selected bibliography on food habits (Socio-economic aspects of food and nutrition) Part 1. Tropical Africa. FAO Library Occasional Bibliographies No. 10.

BERGERET, B., MASSEYEFF, R., PERISSE, J. & LEBERRE, S. (1957) Table de composition de quelques aliments tropicaux Ann. Nutr. Alim. 11, 47-89.

CUYPERS, J.B. (1970) L'alimentation chez les Shi. Musée Royal de l'Afrique Centrale Annales Serie IN-8° Sciences Humaines No. 67, 249 pp.

FOX, F.W. (1966) Studies on the chemical composition of foods commonly used in South Africa. South African Institute of Medical Research, Johannesburg.

de GARINE, I. (1962) Usages alimentaires à Khombolo, Sénégal. Cah. d'Etude Afr. III (10), 218-265.

de MARAIS, J.A.D. (1976) Contribution à la connaissance de l'anthropo- écologie de la malnutrition chez les va'Ndulu (Angola). Masters Thesis of Institut de Médecine Tropicale Prince Leopold, Anvers (Belgium).

den HARTOG, A.P. (1970) Some aspects of food habits in Pantang. Joint F.A.O./W.H.O./O.A.U./(S.T.R.C.) Regional Food and Nutrition Commission for Africa, Accra (mimeo).

GAST, M. (1968) Alimentation des Populations de l'Ahaggar. Mémoires du Centre de Recherches anthropologiques préhistoriques et ethnographiques VIII. Arts et Métiers Graphiques. Paris, 457 pp.

GELFAND, M. (1971) Diet and Tradition in an African Culture. E. & S. Livingstone, Edinburgh, London.

HOLEMANS, K. (1959) Etudes sur l'alimentation en milieu coutumier du Kwango. II. L'enquête familiale directe. Ann. Soc. belge. Med. Trop. Tome 39, 361-373.

IDUSOGIE, E.O. (1973) Centuries of changing food consumption patterns in African communities. Joint F.A.O./W.H.O./O.A.U. Regional Food and Nutrition Commission for Africa. Special Paper No. 8.

JARDIN, C. (1970) List of foods used in Africa. F.A.O. Rome, 328 pp.

LATHAM, M. (1965) Human nutrition in Tropical Africa. F.A.O., Rome, 268 pp.

LEE, R.B. (1965) Subsistence ecology of Kung Bushmen. Ph.D. Thesis, University of California, Berkeley.

LEE, R.B. (1969) Kung Bushman subsistence: an input-output analysis. In: Environment & Cultural Behaviour, A.P. Vayda (Ed.), 47-49. Ecological studies in Anthropology, University of Texas Press, Austin & London.

MASSEYEFF, R., CAMBON, A. & BERGERET, B. (1958) Le groupement d'Evodoula, Etude de l'Alimentation. Orstom, Paris.

McLOUGHLIN, P.F.M. (1970) Africa Food Production Systems. John Hopkins Press. Baltimore, 318 pp.

PERISSE, J. (1959) L'alimentation des populations rurales du Togo. Orstom, Paris (mimeo).

QUIN, P.J. (1959) Food and feeding habits of the Pedi. Witwatersrand Univ. Press, Johannesburg, 278 pp.

RUTISHAUSER, I.H.E. (1962) The food of the Baganda. Uganda Museum Occasional Paper No. 6.

SELINUS, R. (1971) The traditional foods of the Central Ethiopian Highlands. Scandinavian Inst. of Afr. Studies. Research Report 7, Uppsala, Sweden, 34 p.

SILBERBAUER, G.B. (1972) The G/wi Bushmen. In: Hunters and Gatherers Today. M. Bicchieri (Ed.), 271-226. Holt, Rinehart & Winston, New York.

TANAKA, J. (1976) Subsistence Ecology of Central Kalahari. In: Kalahari Hunter-Gatherers. R.B. Lee & I. De Vore (Eds.) Harvard Univ. Press, Cambridge, Mass. and London, 98-119.

THOMPSON, B.P. (1954) Two studies in African nutrition. Rhodes-Livingstone papers, No. 24. Manchester University Press for the Rhodes-Livingstone Institute, 57 p.

TOMITA, K. (1966) The sources of food of the Hadzapi tribe: the life of a hunting tribe in East Africa. In: K. Imanishi, (Ed.), University African Studies I, Kyoto.

WHITBY, P. (1968) Foods of Ghana. Food Research Institute (Accra), Research Bulletin No. 1, 1-31.

WHITBY, P. (1972) Zambian Foods and Cooking. The National Food and Nutrition Programme, Lusaka (mimeo).

YELLEN, J.E. & LEE, R.B. (1976) The Dobe-/Du/da Environment. In: Kalahari Hunters and Gatherers. R.B. Lee & I. De Vore (Eds.) Harvard Univ. Press Cambridge, Mass. and London.

3. Cultural Significance of Plants and Animals

BAHUCHET, S. (1972) Etude écologique d'un campement de pygmées Babinga (région de la Lobaye, République Centrafricaine). J. Agric. Trop. Bot. Appl. XIX (12), 509-559.

BAHUCHET, S. (1975) Rapport sur une mission éffectuée en saison sèche en Lobaye (République Centrafricaine). Observations sur la vie d'une famille de pygmées Bayaka. J. Agric. Trop. Bot. Appl. XXII (4,5,6), 177-197.

BAHUCHET, S. & PUJOL, R. (1975) Etude ethnozoologique de la chasse et des pieges chez les Isongo de la forêt Centrafricaine. In: L'homme et l'animal. Premier colloque d'Ethnozoologie. Inst. Int. Ethnosciences, Paris.

BERNUS, E. (1967) Cueillette et exploitation des ressources spontanées du Sahel nigérian par les Kel Tamasheq. Cahiers Orstom. Ser. Sci. hum. IV (1) 31-51.

BICCHIERI, M. (Ed) (1972) Hunters and Gatherers Today. Holt, Rinehart & Winston, New York.

BIEBUYCK, D. (1973) Lega Culture. Art, initiation, and moral philosophy among a Central African People. University of California Press, Berkeley. 268 pp.

BOSTON, J. (1971) Medicines and Fetishes in Igala (Nigeria). Africa XLI, No. 3, 200-207.

GELFAND, M. (1964) Medicine and Custom in Africa. E. & S. Livingstone. Edinburgh and London, 174 pp.

HAMMOND, P.B. (1966) Yatenga - Technology in the culture of a west African Kingdom. The Free Press, New York. Collier-Macmillan, London 231 pp.

LEBEUF, J.P. (1961) L'habitation des Fali montagnards du Cameroun septentrional. Bibliothèque des Guides Bleus. Libraire Hachette, Paris, 608 pp.

LEE, R.B. & de VORE, I. (Eds.) (1968) Man the Hunter. Chicago, Aldine, 415 pp.

MURDOCK, G.P. (1958) African Cultural Summaries. Unpublished manuscript. New Haven, 2339 pp.

OJO, AFOLABI, G.J. (1966) Yoruba Culture - a geographical analysis. University of Ife and University of London Press.

STAUDER, J. (1971) The Majangir: ecology and society of a Southwest Ethiopian people. Cambridge University Press, Cambridge.

WHITE, C.M.N. (1959) A preliminary survey of Luvale rural economy. Rhodes- Livingstone Paper No. 29. Manchester University Press for the Rhodes- Livingstone Institute, 58 pp.

III. PLANTS

1. Various Uses of Plants

ADAM, J.G. (1962) Le baobab (*Adansonia digitata L.*) Notes afr. (Dakar) 94, 33-44.

ADAM, J.G. (1963) Les plantes utiles du parc national du Niokolo-Koba (Sénégal) (Comment vivre uniquement avec leurs ressources). Notes afr. 97, 5-21.

ANON (1975) Underexploited tropical plants with promising economic value. National Academy of Sciences, Washington, D.C.

BEIDELMAN, T.O. (1964) Some Kaguru Plants: Terms, names and uses. Man 64 (93) 79-82.

BERHAUT, J. (1971) Flore illustrée du Sénégal. Times I-V (not yet complete) Gouvernement du Sénégal. Ministère du Développement Rural, Dakar.

DALE, I.R. & GREENWAY, P.J. (1961) Kenya Trees and Shrubs. Buchanan's Kenya Estates Ltd., Nairobi.

DALZIEL, J.M. (1937) The Useful Plants of Tropical West Africa. Crown Agents for the Colonies, London, 612 pp.

DAVID, N. (1976) History of Crops and Peoples in Northern Cameroon to A.D. 1900. In: Origins of African Plant Domestication. Harlan et al. (Eds.), 223-267.

DUISBERG, P.C. & HAY, J.L. (1971) Economic botany of arid regions. In: W.G. McGinnies, B.J. Goldman and P. Paylore (Eds.) Food, fibre and the arid lands, 247-70. University of Arizona Press.

GILLET, H. Ethnobotanique Centrafricaine. Quelques ressources de la Savane autour du Parc National Saint-Floris. Langues et techniques Nature et Société. II Approche ethnologique, approche naturaliste, 311-315. J.M.C. Thomas et L. Bernot (Eds.) Edit. Klincksieck.

GLOVER, P.E., STEWART, J. & GWYNNE, M.D. (1966) Masai and Kipsigis notes on East African Plants. E. Afr. agric. for J. 32 (2), 184-207.

ICHIKAWA, M. (1978) Ethnobotany of Suiei Dorobo - a preliminary report. Seminar Paper No. 95. Institute of African Studies, University of Nairobi, 41 pp. (mimeo).

IRVINE, F.R. (1961) The Woody Plants of Ghana, with special reference to their uses. O.U.P. London.

KNIGHT, C.G. (1974) Ecology and change; Rural modernization in an African community. New York, Academic Press, 300 pp.

NICOLAISEN, J. (1963) Ecology and Culture of the Pastoral Tuareg. National Museum of Copenhagen.

ORUM, T. (1969) Man and Plants in Ethiopia. Anthropology 44b.

OZENDA, P. (1977) Flore du Sahara. Editions du Centre National de la Recherche Scientifique, Paris, 622 pp.

SCHMITZ, A. (1967) L'Utilisation des plantes du Haut-Katanga. Africa-Tervuren XIII (2), 41-54.

SILLANS, R. & WALKER, A. (1958) Les plantes utiles de Gabon. Essai d'inven- taire et de concordance des noms vernaculaires et scientifiques, description des espèces, propriétés, utilisations. Paris, Ed. Lechavalier, Vol. I.

TANNER, R.E.S. (1951) Some Southern Province trees with their African names and uses. Tanganyika Notes and Records 31, 61-70.

THOMAS, J.M.C. (1959) Notes d'ethonobotanique africaine - Plantes utilisées dans la région de la Lobaye (Afrique Centrale) J.A.T.B.A. VI (8,9), 353-390.

THOMAS, J.M.C. (1961) Quelques plantes connues des Ngbaka de la Lobaye. Journal de la Société des Africanistes XXX, 75-93.

TISSERANT, P.C.H. Catalogue de la flore de l'Oubangui-Chari. Mémoires de l'Institut d'Etudes Centrafricaines No. 2. ORSTOM, Brazzaville.

VERDCOURT, B. & TRUMP, E. (1969) Common Poisonous Plants of East Africa. Collins, London.

VOORHOEVE, A.G. (1965) Liberian high forest trees. Centre for Agricultural Publications and Documentation, Wageningen.

WALKER, R.A. & SILLANS, R. (1961) Les plantes utiles du Gabon, Encyclopédie biologique LVI. Edit. P. Lechavalier, Paris, 614 pp.

WILLIAMSON, J. (1974) Useful plants of Malawi (revised edn.) Government Printer, Limbe.

2. Use of Plants as Food

BERESFORD-PEIRSE, H. (1968) Forest, food and people. F.F.H.C. Basic Study No. 20. F.A.O., Rome.

BUSSON, F.F. (1965) Plantes alimentaires de l'ouest Africain. Thèse à la Faculté des Sciences de l'Université d'Aix-Marseille, 568 pp.

HARLAN, J.R., de WET, J.M.J., & STEMLER, A.B.L. (Eds.) (1976) Origins of African Plant Domestication, Mouton Publishers, The Hague, Paris.

IRVINE, F.R. (1952) Supplementary and emergency food plants of West Africa Econ. Bot. 6 (1), 23-40.

LEE, R.B. (1973) Mongongo: The Ethnography of a major wild food resource. Ecology of Food and Nutrition 2, 307, 321.

PELE, J. & Le BERRE, S. (1966) Les aliments d'origine végétale au Cameroun. Orstom, Yaoundé (Mimeographed).

PORTERES, R. (1950) Les sels alimentaires - Centre d'origine végétale et catalogue des plantes solifères. Organisme d'enquête pour l'étude anthropologique des populations indigènes de l'A.O.F. Direction générale de la Santé Publique, Dakar.

PORTERES, R. (1951) Notes pour servir à une introduction à l'histoire de l'alimentation végétale dans les régions montag- neuses forestières de l'ouest Africain (des Monts de Loma au Massif des Dans). Comptes Rendus Prem. Conf. Internat. Africanistes de l'ouest. II, 82-92. I.F.A.N.

SCHNELL, R. (1957) Plantes alimentaires et vie agricole de l'Afrique Noire. Essai de phytogéographie alimentaire. Paris, ed. Larose, 223 pp.

SCUDDER, T. (1971) Gathering among African woodland savannah cultivators - a case study: the Gwembe Tonga. Zambian Papers No. 5 Manchester University Press, Manchester (for Institute for African Studies, University of Zambia), 50 pp.

SCUDDER, T. (1976) Social Anthropology and the Reconstruction of Prehistoric Land Use Systems in Tropical Africa: a cautionary case study from Zambia. In: Origins of African Plant Domestication. Harlan et al. (Eds. 357-381). Mouton Pub- lishers, The Hague, Paris.

SILLANS, R. (1953) Sur quelques plantes alimentaires spontanées de l'Afrique Centrale. Bull. Inst. Et. Centrafricaines, 5-6, 77-100.

SIMONNEAU, P. (1959) L'homme et la végétation spontanée au Sahara. In: Journées d'information médico-sociales sahar- iennes. Pairs. Comité de coordination scientifique du Sahara.

STORY, R. (1958) Some plants used by bushmen in obtaining food and water. S. Afr. Bot. Surv. Mem. 30.

TALLANTIRE, A.C. & GOODE, P.M. (1975) A preliminary study of the food plants of the west Nile and Madi Districts of Uganda. The utilization of leaves and fruits of local and mainly indigenous plants in supplementing the staple foods. E.A. Agric. For. J. 40 (3), 233-255.

THOMAS, J.M.C. (1960) Sur quelques plantes cultivées chez les Ngbaka de la Lobaye (RCA). Bull. de l'Institut d'Etudes Centrafricaines 19,20: 5-43.

WELMEYER, A.S. (1966) The nutrient composition of some edible wild fruits found in the Transvaal. S. Afr. Med. J. 40, 1102.

3. Use of Plants as Medicine

ADAM, J.G., ECHARD, N., LESCOT, M. (1972) Plantes médicin- ales Hausa de l'Ader (Rép. du Niger). J.A.T.B.A., 141 pp.

BALLY, P.R.O. (1938) Heil- und Giftpflanzen der Eingeborenen von Tanganyika. Beih. Report. Spec. nov. Regni. veg. Band CII.

BOUQUET, A. (1967) Note sur la préparation du poison de flèches dans le Nord- Congo (Brazza). J.A.T.B.A. 14 (8,9), 359-362.

BOUQUET, A. (1969) Féticheurs et médecines traditionnelles du Congo (Brazzaville) Mem Orstom, 36, Paris, 282 pp.

BOUQUET, A. (1972) Plantes médicinales du Congo-Brazzaville. Travaux et documents de l'Orstom, No. 13. Orstom, Paris, 112 pp.

BOUQUET, A. & DEBRAY, M. (1974) Plantes médicinales de la Côte d'Ivoire. Travaux et documents de l'Orstom No. 32. Orstom, Paris, 132 pp.

BOURY, N'D.J. (1962) Végétaux utilisés dans la médecine africaine dans la région de Richard-Toll (Sénégal). Notes Africaines 93, 14-16.

COOSTEIX, P.J. (1961) L'art et la pharmacopée des guérisseurs Ewondo région de Yaoundé. Recherches et Etudes Camérouna- ises 6 (3), 5-87.

EVERARD, C.O.R. (1966) Some poisonous plants with special reference to those having rodenticidal potential, Part I. Literature Survey, Ibadan.

FRATKIN, E.M. (1975) Herbal medicine and concepts of disease in Samburu. Seminar Paper No. 65. Institute of African Studies, University of Nairobi. (mimeo).

GREENWAY, P.J. (1941) East African Plants of Proved or Potential Value as Drug Producers. E. Afr. Agric. J. 6, 127-34.

HAERDI, K.J. & ADAM, J.G. (1964) Afrikanische Heilpflanzen. Plantes Médi- cinales africaines. Acta Tropica Supplementum 8. 331, pp.

HARLEY, G.W. (1970) Native African Medicine with special reference to its practice in the Mano Tribe of Liberia. Frank Cass., London.

KERHARO, J. (1950) Sorciers, féticheurs et guérisseurs de la Côte d'Ivoire- Haute-Volta. Paris, Vigot edit.

KERHARO, J. (1971) L'aromathérapie et la gemnothérapie dans la pharmacopée sénégalaise traditionnelle. J.A.T.B.A. XVIII (4,5,6), 109-141.

KERHARO, J. (1975) Traditional Pharmacopeoeas and Environment. African Environment 1 (4), 30-39.

KERHARO, J. & BOUQUET, A. (1950) Plantes médicinales et toxiques de la Côte d'Ivoire-Haute-Volta. Orstom edit. Paris, Vigot, 295 pp.

KERHARO, J. & ADAM, J.G. (1974) La pharmacopée sénégalaise traditionnelle. Plantes médicinales et toxiques. Paris, Vigot Frères, 1011 pp.

KOKWARO, J.O. (1976) Medicinal Plants of East Africa. East African Literature Bureau, Nairobi.

OLIVER, B. (1960) Medicinal Plants in Nigeria. Nigerian College of Arts, Science & Technology.

OUMAR, F.A. (1962) Traitement des morsures de serpents avec des plantes de Djolof (Sénégal). Notes Africaines 93, 13-14.

SABBAH-SALOMON, C. (1948) Contribution à l'étude du Droguier Marocain. Dr. Thèse Faculté de Pharmacie, Université de Strasbourg. 82 pp.

STRELCYN, S. (1966) Les "médecines du Begamder et du Tchelga" (Ethiopie) d'Abbaba Garrdd. Africana Bulletin (Warsaw) 5, 53-93.

STRELCYN, S. (1968) Médecine et plantes d'Ethiopie. Les traits médicaux éthiopiens. Prace Orientalistyczne, Tom. XIV. Polskiej Academic Nauk, Warsaw, 798 pp.

STRELCYN, S. (1973) Médecine et plantes d'Ethiopie II. Enquête sur les noms et l'emploi des plantes en Ethiopie. Napoli: Instituto Universitario Orientale, 279 pp.

VERGIAT, A.M. (1970) Plantes magiques et médicinales des féticheurs de l'Oubangui (Région de Banqui). J. Agric. Trop. Bot. App. (no Vol. given), 238 pp.

WATT, J.M. (1966) African plants potentially useful in mental health Lloydia 30, 1-22.

WATT, J.M. & BREYER-BRANDWIJK, M.G. (1962) Medicinal and Poisonous Plants of Southern and Eastern Africa. E. & S. Livingstone, Edinburgh and London, 1457 pp.

4. Use of Plants as Fodder for Domestic Stock

ANON (1977) Agricultural Development in the Sebel Marra Area. Annex III Livestock and Range Resources. Hunting Technical Sciences Ltd., Elstree Way, Borehamwood, Herts, U.K.

BOGDAN, A.V. (1977) Tropical Pasture and Fodder Plants. Longmans, London and New York, 475 pp.

TOTHILL, J.D. (Ed.) (1948) Agriculture in the Sudan. O.U.P., London.

WICKENS, G.E. (1969) A study of Acacia albida (mimosoideae). Kew Bull. 23, 181-202.

5. Use of Plants in Construction (houses, utensils, tools) and Crafts

CHAPPEL, T.J.H. (1977) Decorated gourds in north-eastern Nigeria. Ethnographica. The Nigerian Museums, Lagos, 277 pp.

GARDI, R. (1973) Indigenous African Architecture. English translation by Sigrid MacRae. Van Nostrand Reinhold Col., New York, 248 pp.

HASELBERGER, H. (1964) Bautraditionen der west-afrikanischen Negerkulturen. Verlag Herder, Vienna, 176 pp.

KNUFFEL, W.E. (1973) The construction of the Bantu Grass Hut. Akademische Druck-u. Verlagustalt Graz - Austria, 85 p.

OLIVER, P. (Ed.) (1971) Shelter in Africa. Barrie & Jenkins, London.

PLUMER, C. (1970) African Textiles - an outline of handcrafted Subsaharan Fabrics. African Studies Center Dept. of Human Environment & Design, Michigan State University, 146 pp.

WENGER, S. & BEIER, H.U. (1975) Adire, Yoruba Pattern Dyeing, Nigeria Magazine 54, 208-225.

WHITE, L. (1974) Natural dyes and dyeing techniques in ethnography. MS. Paper for the Diploma in Conservation, Inst. of Archaeology, London (mimeo), 102 pp.

6. Use of Plants as Fuel

BERTRAND, A. (1977) Les problèmes du bois de chauffage et du charbon de bois en Afrique tropicale. Bois et forêts des Tropiques 173, 39-48.

DOAT, J. & PETROFF, G. (1975) La carbonisation des bois tropicaux. B.7.T. No. 159.

EARL, D.E. (1975) Forest energy and economic development. Clarendon Press, Oxford.

ECKHOLM, E.D. (1975) Une crise dont on ne parle pas : la pénurie de bois dans les pays sous-développés et ses conséquences. Ceres, Nov.-Déc. 1975.

OUEDRAOGO, MM.M.M. (1974) L'approvisionnement de Ouagadougou en produits vivriers, en eau et en bois. C.V.R.S. Université Bordeaux IV.

UHART, E. (1975) Le charbon de bois en zone sahélienne. Commission écono- mique pour l'Afrique. Addis-Abbeba. July 1975.

7. Cultural Significance of Plants

BESMER, F.E. (1977) Initiation into the Bori cult: a case study in Ningi town. Africa 47 (1), 1-13.

LEBEUF, J.P. (1962) Pipes et plantes à fumer chez les Kotoko. Notes Africaine 93, 16-17.

PORTERES, R. (1965) Le caractère magique originel des haies vives et de leur constituants (Europe et Afrique occidentale). J.A.T.B.A. XII (4 à), 133-291.

STEFANISZYN, B. (1964) Social and Ritual Life of the Ambo of Northern Rhodesia, London, O.U.P.

STRELCYN, S. (1955) Prières éthiopiennes pour délier les charmes. Rocznik orientalistyczny (Warsaw).

WEIL, P.M. (1971) The Masked Figure and Social Control: The Mandinka Case. Africa XLI, (4), 279-293.

IV. ANIMALS

1. Various Uses of Animals

ANON (1975) L'Homme et l'Animal. Premier colloque d'Ethnozoologie. Inst. Int. Ethnosciences, Paris, 644 pp.

BROKENSHA, D., MWANIKI, H.S.K. & RILEY, W. (1972) Beekeeping in Embu District, Kenya. Bee World 53 (3), 114-123.

CHILD, G. (1970) Wildlife utilisation and management in Botswana. Biological Conservation 3 (1), 19-22.

CLOUDSLEY-THOMPSON, J.L. (1970) Animal utilization. In: H.E. Dregne (Ed.) Arid Lands in transition, 57-72. Amer, Ass. Adv. Sci. Washington, D.C.

DE KLOBUSITZKY, D. (1971) Animal venoms in therapy. In: Venomous Animals and their Venoms III. W. Bucherl and E.E. Buckley (Eds.), 443-478. Academic Press, New York, London.

KUNDAELI, J.N. (1976) Commercial Exploitation of the Tree Hyrax on Mt. Kilimanjaro. Tanzania Notes and Records 79 and 80, 57-64.

LEVY-LUXEREAU, A. (1972) Etude ethno-zoologique du Pays Hausa, en République du Niger. Société d'Etudes Ethnozoologiques et Ethno-botaniques. Paris, 341 pp.

RINEY, T. & HILL, P. (1967) Conservation and Management of African Wildlife. English speaking country reports. African Special Project Stage III. F.A.O.

2. Use of Animals as Food (meat)

AIYEDEUN, B.A. & ADEGBOYE, J.D. (1967) River fisheries survey in Northern Nigeria. Nigerian Field 32 (4), 160-170.

AJAYI, S.S. (1971) Wildlife as a source of protein in Nigeria: some priorities for development. The Nigerian Field, 36 (3), 115-127.

AJAYI, S.S. (1974) Giant rats for meat and some taboos. Oryx 12, 379-380.

AJAYI, S.S. (1977) Live and carcass weights of giant rat *Cricetomys gambianus* Waterhouse and domestic rabbit *Oryctolagus cuniculus L.* E. Afr. wildl. J. 15, 223-227.

ANON (1961) Le poisson de fleuve dans l'Ouest Africain. Ministère de la Coopération, 69 pp.

ASIBEY, E.O.A. (1966) Wild animals and Ghana's economy. Investigations into bushmeat as a source of protein. Ghana Game & Wildlife Department (mimeo), 33 pp.

ASIBEY, E.O.A. (1969) Grass-cutter (*Thyronomys swinderianus*) as a source of bushmeat in Ghana. Department of Game & Wildlife, Accra (44 pp. mimeo).

ASIBEY, E.O.A. (1971) The present status of wildlife conservation in Ghana. In: Wildlife Conservation in West Africa. D.C.D. Happold, (Ed.), 15-21. IUCN Publications new series No. 22.

ASIBEY, E.O.A. (1972) Wildlife as a source of protein in Africa south of the Sahara: African Forestry Commission, ad hoc working party on wildlife Management, F.A.O., Rome (mimeo, FO:AF/wl:72/8).

ASIBEY, E.O.A. (1974) Wildlife as a source of protein in Africa south of the Sahara. Biol. Conservation 6, 32-39.

ASIBEY, E.O.A., & EYESEN, K.K. (1975) Additional information on the importance of wild animals as a food source in Africa south of the Sahara. J. Ghana Wildlife Soc. 1,2, 13-17.

ASIBEY, E.O.A. (1976) The effects of land use patterns on future supply of bushmeat in Africa south of the Sahara. 5th Session, working party on Wildlife Management and National Parks. FO:AFC/WL:76/6/4) (mimeo. 9 pp.).

BEQUAERT, J.C. (1950) Studies in the *Achatinae*. Bull. Mus. Comp. Zool. Harvard 105.

BODENHEIMER, F.S. (1951) Insects as Human Food. Dr. W. Junk, Publishers. The Hague.

BROSSET, A. (1966) La Biologie des Chiroptères. Masson & Cie. Paris.

BUTYNSKI, T.M. (1973) Life history and economic value of the spring hare (*Pedetes carpernis* Forster) in Botswana. Botswana Notes and Records 5, 209-213.

BUTYNSKI, T.M. & Von RICHTER, W. (1974) In Botswana most of the meat is wild. Unasylva 26 (106), 24-29.

CHARTER, J.R. (1971) Nigeria's wildlife: a forgotten national asset. In: IUCN Publication, New Series No. 22, Morges, Switzerland.

CLOTTEY, St. John A. (1971) Wildlife as a source of protein in Ghana. African working party on Wildlife Management. FO:AFC/WL-69/9, 5 pp. mimeo.

CLOTTEY, St. John A. (1971) Wildlife as a source of protein in Ghana. Food & Nutrition in Africa, No. 9, 7-11 pp.

CREMOUX, P. (1963) The importance of game meat consumption in the diet of sedentary and nomadic peoples of the Senegal River Valley. In: IUCN Publ. New Series 1, 127-129.

CURRY-LINDAHL, K. (1969) Report to the Government of Liberia on Conservation Management and Utilisation of Wildlife Resources. IUCN Publications, New Series, Supplementary Paper, No. 24.

CURRY-LINDAHL, K. (1969) Report to the Government of Ghana on Conservation, Management and Utilisation of Ghana's Wildlife Resources. IUCN Publications, New Series, Supplementary Paper No. 18.

CURRY-LINDAHL, K. (1972) Conservation for Survival. London, Victor Gollanez Ltd., 335 pp.

DELMET, C. (1975) Extraction d'huile comestible d'*Agonoscelis versicolor* Fabricius, Heteroptere *Pentatomidae*, au Djebel Guli, Soudan. In: l'Homme et l'Animal. Premier colloque d'ethnozoologie. Inst. Int. d'Ethnoscience, Paris.

den HARTOG, A.P. & de VOS, A. (1973) The Use of Rodents as Food in Tropical Africa. F.A.O. Nutrition Newsletter 11 (2), 14 pp.

de SURGY, A. (1966) Les Pêcheurs de Côte d'Ivoire Tome II. Les Pêcheurs Lagunaires. Centre National de Recherche Scientifique & Centre National de Documentation de Côte d'Ivoire (I.F.A.N.), 144 pp.

de VOS, A. & KAITTANY, K. (1972) Economic value of wildlife in Africa. A paper produced for the Seventh World Forestry Congress, 1972 - Forestry Resources Division. F.A.O., Rome (mimeo).

de VOS, A. (1978) Game as Food. UNASYLVA 29 (116), (in press).

GUY, R.D. (1972) The honey hunters of Southern Africa. Bee Wld. 53(4), 159-66.

HALSTEAD, L.B. (1977) Fruit bats an example of wildlife management. Nigerian Field 42 (2), 50-56.

HEYMANS, J.C. & EVERARD, A. (1970) Contribution à l'étude de la composition alimentaire des insectes comestibles de la Province du Katanga. Problèmes Sociaux Congolais, 90-91: 333-340.

HEYMANS, J.C. & MEURICE, J.C. (1973) Introduction à l'exploitation de la faune, comme ressource alimentaire en République du Zaire. Forum Universitaire 2, 6-12.

HEYMANS, J.C. & MEURICE, J.C. (1973) L'exploitation de la faune sauvage en République du Zaire. Les Naturalistes Belges 54 (6), 246-254.

HOLDEN, M. & REED, W. (1972) West African Freshwater Fish. Longman.

HUNTER, J.B. (1969) A survey of the oyster population of the Freetown estuary, Sierra Leone, with notes on the ecology, cultivation and possible utilisation of mangrove oysters. Trop. Sci. 11, 276-285.

JEFFREY, S. (1977) How Liberia uses its wildlife. Oryz XIV (2), 168-173.

KUNDAELI, J.N. (1976) Commercial exploitation of tree hyrax on Mt. Kilimanjaro. Tanzania Notes & Records 79/80, 57-64.

MARKS, S.A. (1973) Prey selection and annual harvest of game in a rural Zambian community. E. Afr. Wildl. J. 11, 113-128.

ORRACA-TETTEH, R. (1963) The Giant African Snail as a source of food. In: The better use of the world's fauna for food. J.D. Ovington (Ed.) 53-61. Institute of Biology, London.

OVINGTON, J.C. (Ed.) (1963) The better use of the world's fauna for food. Symposia of the Institute of Biology No. 11, Institute of Biology, London.

PATERSON, P.D. (1966) The present economic status of *A.M. adonsonii*: Summary and Bibliography. Bee Wld. 47 (4), 123-131.

PHELPS, R.J., STRUTHERS, J.K. & MOYO, S.J.L. (1975) Investigations into the nutritive value of *Macrotermes falciger* (Isoptera-Termitidae). Zoologica Africana 10 (2), 123-132.

REED, W. (1967) Fish and Fisheries of Northern Nigeria. Min. of Agric. Zaria.

SABATER, PI.J. & GROVES, C. (1972) The importance of higher primates in the diet of the Fang of Rio Muni. Man 7 (2), 239-243.

SIKES, S. (1973) Survey of Wildlife in Benue-Plateau State, Nigeria: 1970-71. Wildlife Bulletin of Nigeria 1 (1), Federal Department of Forestry, Ibadan.

TALBOT, L.M. et al. (1965) The meat production potential of wild animals in Africa. Technical Communication No. 16. Commonwealth Agricultural Bureau. Farnham Royal, U.K.

TALBOT, L.M. (1966) Wild animals as a source of food. Spec. sci. Rep., Wildlife No. 98, U.S.D.I., Washington, D.C., 16 pp. (mimeo).

TIHON, L. (1946) A propos des termites au point de vue alimentaire. Bulletin agricole du Congo Belge 37, 865-868.

von RICHTER, W. (1970) Wildlife and rural economy in Southwest Botswana. Botswana Notes & Records 2, 85-94.

von RICHTER, W. & BUTYNSKI, T. (1973) Hunting in Botswana. Botswana Notes & Records 5, 191-208.

WHITTLE, C. & P. (1977) Domestication and breeding of Maxwell's Duiker. Nigerial Field 42 (4), 13-21.

3. Cultural Significance of Animals

BAHUCHET, S. (1975) Ethnozoologie des Pygmées Babinga de la Lobaye, République Centrafricaine. In: l'Homme et l'Animal. Premier colloque d'Ethno-zoologie. Inst. Int. Ethnoscience, Paris.

BEN AMOS, P. (1975) Animals in Benin Art.

DELMET, C. (1975) Interdits "animaux" liés la grossesse du Djebel Guli (Soudan). In: l'Homme et l'Animal. Premier colloque d'Ethnozoologie. Inst. Int. d'Ethnoscience, Paris.

DOUGLAS, M. (1957) Animals in Lele religious thought. Africa 27 (1), 46-58.

FORDE, D. (1964) Yakö Studies. O.U.P. London.

FRATKIN, E. (1974) Why elephant is an old woman: animal symbolism in Samburu. Seminar Paper No. 63. Institute of African Studies, University of Nairobi. (mimeo).

GOUFFE, C. (1975) Noms vernaculaires d'animaux et ethonozoologie, le point de vue du linguiste (lexicologie Haussa). In: l'Homme et l'Animal. Premier colloque d'Ethnozoologie. Inst. Int. d'Ethnosciences, Paris.

HUBER, H. (1963) The Krobo - traditional social and religious life of a West African people. Studia Instituti Anthropus Vol. 16, Anthropus Institute, St. Augustin, Near Bonn, 306 pp.

LAUVERJON-CARCIU, M. (1975) Crocodiles sacrés de Haute-Volta. In: l'Homme et l'Animal. Premier colloque d'Ethnozoologie. Inst. Int. d'Ethnoscience. Paris.

LOBJOIT, J. (1975) Le pangolin et l'homme. In: l'Homme et l'Animal. Premier colloque d'Ethnozoologie. Inst. Int. d'Ethnosciences. Paris.

MANKATO MA MBAELELE (1978) Part of African culture. Unasylva 29 (116), 16-17.

MARKS, S.A. (1976) Large Mammals and a Brave People: Subsistence Hunters in Zambia. Univ. of Washington Press, Seattle.

MARKS, S.A. (1977) Buffalo movements and accessibility to a community of hunters in Zambia. E. Afr. Wildl. J. 15, 251-261.

MARKS, S.A. (1977) Hunting behaviour and strategies of the Valley Bisa in Zambia. Human Ecology 5 (1), 1-36.

MEILLASSOUX, C. (1964) Anthropologie économique des Couro de Côte d'Ivoire. Mouton, Paris, 382 pp.

PAGEZY, H. (1975) Les interrelations homme - faune de la forêt du Zaire. In: l'Homme et l'Animal. Premier colloque d'Ethnozoologie. Inst. Int. d'Ethnoscience. Paris.

PALAU MARTI, M. (1975) Animaux symboliques du roi au Dahomey. In: l'Homme et l'Animal. Premier colloque d'Ethnozoologie. Inst. Int. d'Ethnosciences. Paris.

PELLETER, F.X. (1975) Symbiose entre l'Amrig et le dauphin sur la côte Mauritanienne. In: l'Homme et l'Animal. Premier colloque d'Ethnozoologie. Inst. Int. d'Ethnosciences. Paris.

STRELCYN, S. (1975) Un recueil de recettes médico-magiques éthiopiennes à base de matière animale. Zootecnica e Vita (Messina) XVIII (1 & 2), 125-132.

TUBIANA, M.J. (1975) Interdits claniques et animaux (Zaghawa du Tchad et du Soudan). In: l'Homme et l'Animal. Premier colloque d'Ethnozoologie. Inst. Int. d'Ethnosciences. Paris.

WILLIS, R.G. (1974) Man and Beast (among the Fipa, Nuver, Dinka and Lele). Hart Davis, London.

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